THE

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"ELECTRICAL REVIEW."

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THE

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THE EUROPEAN GLOW LAMP COMBINE.

THE recent constitution of an international syndicate of makers of incandescent electric lamps in Germany, Austria and Holland has not been accepted as a blessing either by merchants or electric lighting companies on the European Continent, to say nothing of the consumers, who will eventually have to provide out of their own pockets the money required for the maintenance of the syndicate and the payment of the profit of its members. It is known that the prices of glow lamps have been in a depressed condition during the past two years, but even these are firmly believed to have yielded a small profit to makers, notwithstanding the latter's assertions to the contrary. At any rate, the idea of forming a syndicate was promoted a few months ago, and the sole object of the combination, as was reported, apparently on behalf of the interested works at the time, was to restore prices to the level prevailing two years ago, and maintain them on a stable basis; but a further increase was said not to be contemplated in the future. Certain difficulties arose which at one time threatened to wreck the scheme, but these were finally overcome, and the syndicate was brought into existence. One firm is stated to have been actually compelled to join the combination or run the risk of being boycotted by the glass works, and the former alternative was found to be the preferable course to adopt in order to avoid expense and loss.

The syndicate has been registered in Berlin with a capital of £50,000, under the title of the United Glow Lamp Works Co., and the capital is divided among the members in proportion to the maximum production allotted to each works. Managed by representatives of three works, the syndicate undertakes the purchase of the total output of the makers at a definite price, and after selling the lamps through the sales bureau in Berlin, and meeting the expenses of this central establishment, the proceeds are distributed among the shareholders. It will thus be seen that each maker has only to deal with a fixed production, and he is, therefore, able to devote attention to the manufacture of the number of lamps allotted to him so as to turn out this particular quantity in the most economical manner, and, in fact, more economically under the circumstances than would be the case were he to trade directly with his customers, as in former times, when orders were received in an irregular way. But, notwithstanding this saving, the successful creation of the syndicate was immediately followed by an advance in prices to the extent of 100 per cent. As the makers previous to the formation of the combination contended that the selling prices only represented the actual cost of production, it will be obvious that the doubling of quotations on the establishment of the syndicate indicates very handsome profits to the members, although these will not be enjoyed until the completion of contracts which were entered into by makers individually some time ago.

The considerable advance which has already been made in prices, with the prospect that is thought to exist of a further increase consequent on the exhaustion of the supplies still in the hands of consumers and merchants, has already attracted a certain amount of attention in Germany, while in Austria the result has been to provoke considerable indignation and opposition. The first to make a stand against the high handed action of the syndicate are the three electric lighting companies in Vienna, which consider that, in the interests of both consumers and themselves, the doubling of prices should be accompanied by a material improvement in the quality of the lamps. As, however, there is no guarantee that the lamps to be delivered in the future will be at all superior to those supplied in the past, the three companies have mutually made arrangements to impose more stringent conditions in regard to purchases from the present time. It is also proposed to test five out of every hundred new lamps for a period of 48 hours in order to ascertain the consumption of current and illuminating power, and to urge the electro-technical societies and supply works in Austrian provincial towns to join the movement in opposition to the syndicate. This action has been endorsed by the Vienna Town Council, which has given instructions to the engineers at the municipal electric supply works to prepare a scheme for the establishment of a municipal glow lamp factory, and to suggest to the Association of Electricity Works the desirability of acquiring or establishing a lamp factory in the interests of the stations which it represents, and of making the conditions of acceptance of lamps of a more rigorous character. At the same time, the Town Council has determined to place itself independently in communication with the provincial electricity works in order that common action may be taken in opposition to the syndicate.

It is assumed that the campaign which has been inaugurated by the Austrian companies and local authorities is intended to stimulate similar opposition in Germany, but it is as yet too early to say whether any steps will be taken in the same direction in the latter country. The resistance being offered to the operations of the syndicate is not restricted to supply companies and town councils, which may or may not supply their customers with lamps, seeing that merchants are not exceedingly well pleased with the policy of the combination in so far as it is known at the present time. In the first place, the syndicate stipulates that lamps are only to be used in the country for which they are purchased. It, therefore, follows as a further consequence that when the annual maximum allotted production of one firm has been sold by the syndicate, the customers who desire further supplies of that firm's particular types will have to content themselves with the makes of other members of the combination, but which may not suit the actual requirements of the prospective buyers. Secondly, the rebates allowed to merchants only range from 12½ per cent. to 20 per cent., but even the latter is considered to be inadequate to compensate for the risk of breakages of bulbs and filaments and the expenses attending the exchange of lamps, which many dealers undertake to do in order not to lose their customers.

It remains to be seen whether the opposition will grow, and what the ultimate results will be, but as the syndicate is expected to earn for its members an additional profit of over £4,000 per million lamps sold, it can readily be understood that the export trade will be pushed to the utmost at the expense of consumers in Germany, Austria and Holland. This apparently means that increased competition may be expected in Great Britain.

South African Electrical Work.

Two articles relating to South African electrical affairs which appear in this issue will, we venture to believe, be read with special interest by electrical engineers in this country. The account of the cable-laying operations and its accompanying interesting photographs bring the engineer at home into touch with the work and difficulties of his brother in Johannesburg. And it must bring rejoicing to the heart of the manufacturer who is on the alert for industrial movements, as well as to the central station man, who is never so happy as when he has some extension of his system in hand, to have this practical evidence that in the locality where but yesterday siege trenches were made, there are to-day peaceful operations proceeding for the extension of electric lighting mains. The development of the Durban lighting and traction system, the story of which we shall conclude in our next issue, will also acquaint our readers with the excellent progress made there with an installation started six years ago, but which has been so fortunate as to be entirely free from the rivalry created by the existence of gas lighting interests. How some of our home electricity works engineers and managers will pine for a free field, when they think of Durban without a gas supply, and minus the misrepresentations of gas companies! Is there not some justification for believing that public electricity supply and tramway work in South Africa will develop very much upon the same lines that our stations are developing along? A good deal of the work will be very largely controlled by men who have been responsible for the design and working of such undertakings in the United Kingdom.

The Legal Position of the Consulting Engineer.

We believe that anything relating to the legal position of the consulting engineer, especially in regard to the exercise of autocratic privilege which his municipal client elects to confer upon him, and to unjustly impose upon the would-be contractor, is of interest just now. We have often dealt at length with this matter from an editorial point of view, and ample evidence has come to hand from contractors and manufacturers that the topic is none the less serious because it is an every-day one with them; we therefore think that the contribution in this issue, which discusses the matter from the standpoint of the lawyer, will be read with equal interest both by consulting engineers and by contractors.

The B. of T. Suggestions *re* Tramways.

In our issue of September 11th attention was drawn by means of a short article to certain suggestions made by the Board of Trade in a letter to tramway undertakers. These suggestions have been criticised, as desired by their framers, who should have sufficient evidence by now of the general feeling with regard to them.

It is unnecessary to say that the various opinions are often most conflicting, and, as might be expected, some are amusing and some are foolish; but we deal here only with the notes received by the Tramways and Light Railways Association and printed in their official circular for November.

One set is from a tramway system 92 miles long, and another set from a 10-mile system, both company-owned. The bigger system objects to folding steps, and states that the fixed step has never been the cause of any accident, while the smaller thinks that the fixed step does interfere with the full action of a trigger lifeguard. We agree that it must be disappointing to anyone who falls in front of a car to be hit by a rigid steel step after missing the bumper, the brake-staff, the coupling gear, and the other low-hung working attachments under the platform, and that a folding step is a desirable device if its several disadvantages, and even dangers, can be overcome. At the same time we feel that the gentleman who speaks for the 10-mile road, need not have curtailed his "screen" or "gate" in such a manner as to leave a portion of the track unguarded on account of the presence of the step if he had made use of the auxiliary swinging gate,

which is quite a common feature of trigger guards at the present time.

The opinions as to reversed staircases are somewhat different in the two cases, the large road asserting that neither the view nor the movements of the motorman are more restricted with this type than with the old open type, the safety of the passengers being better guarded by the former, while the small road has inserted a piece of plate-glass in the riser of one of the steps to enable the motorman to see vehicles debouching from side streets. We have expressed an opinion already that the motorman has no concern with bodies in motion that "open up" the car after the motorman himself has passed them. He has quite enough to do to keep his eyes "front," his field of vision extending only 90° on either side of the centre of the track, a range permitted by the reversed staircase as usually constructed.

On the other hand, we believe that the B. of T. do not desire comparisons to be made with the old open stairway, so much as with a new staircase which combines the safety of the reversed type with a much wider field of vision.

Either the 10-mile road is new, or the immunity from trolley accidents is very striking; otherwise we do not understand this note :—

"Trolley Heads.—All our heads are of a pattern that, in the event of being pulled off, they cannot fall to the ground unless the contact cable becomes broken, *which is not likely*."

It is, on the contrary, only too likely. When a trolley head gets "good and jammed," something has to go, and one always prays that it may be the cable rather than the boom or the whole standard, or the roof !

Such bad accidents should become month by month less and less frequent if sufficient interest is shown in obtaining the best kinds of trolley heads now on the market. The worst that should now befall when a head fouls the overhead construction is, that the head alone is pulled off. If it is attached by a light chain to the boom it will not fall to the ground (all heads should clear the car itself) unless it is fouled badly enough to break the chain. Even then it will fall within a few feet of the back end of the car in the clear wake that usually exists behind a swiftly moving vehicle. The best kind of head is that which releases itself automatically when caught in an overhead trap, and there is at least one that does this with fair certainty.

When overhead "traps" have been reduced to a minimum, as suggested by the B. of T., when overhead special work is more reliable, and when the use of a safe trolley head is general, the number of electrical accidents reported monthly to the B. of T. will be comparatively insignificant.

Radium as a Generator of Electricity.

Curie has shown that radium is a constant generator of heat, and now Wien has shown that by a suitable arrangement radium may be made a constant source of electricity. Rutherford has shown that both positive and negative electrons are thrown off by radium, and since the size of the positive electrons is several hundred times greater than that of the negative electrons, all that is necessary to separate them is a sieve which will allow the negative electrons to pass through while it retains the positive electrons. Many substances are capable of acting as sieves in this way—for example, glass. Wien (*Phys. Zeit.*, September 1st) enclosed radium bromide in a glass tube into which a platinum wire was fused, and the positive electricity collecting inside was drawn off by this wire. This tube was suspended by a glass thread in a larger tube into which a second platinum wire was melted. The current was found to be of the order of 3×10^{-12} amperes. The radiated masses of the electrons calculated from this current came out for the positive particles $4{\cdot}6 \times 10^{-17}$ gram per second, and $2{\cdot}9 \times 10^{-20}$ gram per second for the negative particles. It is, therefore, totally impossible to determine the radiated masses by weighing. The energy of radiation, owing to the high velocity of the particles, is considerable, being for the positive electrons 60 ergs per second, and for the negative 8·7 ergs per second, from 4 milligrammes of radium bromide.

A New Electrical Resistance Furnace.

At the last general meeting of the German "Bunsen" Society for Applied Physical Chemistry, Dr. O. Frölich read a paper giving a preliminary description of a new resistance furnace for which he had applied for a German patent. The idea underlying this apparatus is apparently to use the sides of the furnace itself, or at least four of them, as the immediate sources of heat, instead of employing one or more specific cores of carbon or the like. The author stated that he had discovered a material for making the furnace walls which has 16 times the resistivity of carbon when hot and 25 times its resistivity when cold; and that he has met with a suitable material for insulating these walls which does not conduct electricity at a white heat. The author's furnace is surrounded with a jacket of refractory material, which is also a bad heat conductor, an air space being left between the furnace and its covering. A small experimental apparatus has already been tested; when the heat came only from two vertical electrodes which were raised to bright redness, the mean temperature in the furnace was about 1,200° C.; but when two or more of the walls themselves were heated electrically, the mean temperature rose to 1,600° C., and could be pushed still higher. The substance used in constructing these walls does not melt till considerably above 2,000° C. In the discussion following the paper, Drossbach remarked that bodies like refractory metallic oxides become better conductors as they are the more impure; impurities in the shape of strongly acid oxides, such as certain compounds of titanic acid, are particularly powerful in promoting conductivity at low temperatures. Nernst pointed out that pure oxides do not conduct appreciably at temperatures of about 1,700°, but mixtures of oxides are conductors at that temperature. For instance, neither pure thoria nor pure magnesia is a conductor, but a mixture of them is; just as happens in the case of pure water, pure sulphuric acid, and mixtures of acid and water. The knowledge on the subject of the conductivity of single and mixed metallic oxides, which had accumulated in the speaker's laboratory until it covered most oxides and many of their mixtures at a temperature of about 1,700° C., would appear to have been overlooked by the author of the paper and others present at the meeting.

Fuel Economy from the Chemical Point of View.—This is the title of a paper by Mr. J. B. C. Kershaw, read before the Liverpool Engineering Society. The author is one of those to whom the waste of our fuel resources appeals as a crime against posterity. There can be no doubt of the wastefulness of our present ways of using fuel, and there is an immense field for reform in this connection. The author deals with his subject from the calorific standpoint, advocating the chemical examination of fuel and also of water, for waste may arise from bad water as from bad coal. He next deals with the combustion of fuel in the furnace, in which he points out the difficulties arising from the hydro-carbons. There are no insuperable difficulties, of course, the troubles met with really arising from the neglect of those obvious principles of combustion which underlie good practice. We are glad to see that Mr. Kershaw insists on the removal of the cold boiler from the burning hydro-carbons, so that the necessary temperature may be secured. In Section IV. the author advocates a proper analysis of the flue gases as a check on the process which has gone before, and concludes with certain figures from station practice to show how far from ideal conditions practice has fallen. An appendix contains extracts from Mr. Stromeyer's report to the Manchester Steam Users' Association, and a set of approximate coal analyses.

D

THE DESIGN OF DIRECT-CURRENT MACHINERY.

By VAL. A. FYNN.

(*Continued from page* 850.)

It seems to the writer that a far better way is to specify for the commutator and brush-gear not to exceed a certain temperature rise, and leave the rest to the maker. The latter may have very good reason for using a quality of carbon permitting of a much higher actual density without undue heating or undue loss.

A good many specifications to which makers are asked to quote, contain many a clause which simply represents so much wasted printers' ink.

We might mention the time-honoured formula "the armature is to be built up of thin soft Swedish iron discs carefully insulated from each other, &c." If there is a maker to be found who will make his armature of solid cast-iron, and come up to the invariably strict restrictions as to temperature rise and to the specified efficiency, he ought certainly to be given a chance.

We have often seen the number of slots and commutator segments specified as well, but notwithstanding these various restrictions, a clause is always to be found disclaiming all responsibility on the part of the consulting engineer, and making the machine liable to rejection if not within the temperatures and efficiencies specified.

We distinctly think that the consulting engineer should either specify all the details of the machine, and be responsible for the results himself, or he should specify the results and leave the maker to obtain them in his own way.

In considering the armature proper, we will only refer to the slotted drum, and draw attention to the advisability of firmly supporting the teeth, preferably by means of brass castings as shown in fig. 14. It will be noted that the

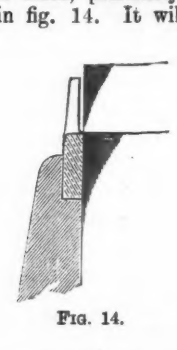


Fig. 14.

brass teeth stop short of the outer diameter, so as to miss as much as possible of the field fringe and avoid eddy currents due to it. It is good practice to set these teeth back to a slight extent away from the laminations, they are often rather weak, and this reduces the pressure on them whilst still compressing the laminations sufficiently.

There remains to be considered the mechanical aspect of the winding. It will be generally admitted that a symmetrical winding is essential, and the necessity of reducing the soldered joints to the strictest minimum will probably not be questioned. It is necessary for all the elements of a winding to be strictly identical; the more so, the closer the design. This is out of the question with any but a symmetrical winding, and soldered joints are very liable to introduce faults.

This being so, the choice rests between the former-wound coil and the hand-wound barrel winding, avoiding all soldered joints, for any number of wires per slot per layer, as introduced by the writer some six or seven years ago, and since largely used both here and abroad. Fig. 15 shows this process of winding, and fig. 16 is an example of the completed armature.

Of the former-wound coils, those of the Eickemeyer type are being completely abandoned—no doubt, on account of the poorer opportunity for ventilation which they afford—and the barrel type is now in general use. The writer is aware that this type of coil is mostly specified, but, personally, he very much prefers the hand-wound armature for most kinds of work. The greatest advantage claimed for the former seems to be the ease with which repairs can be carried out. This contention only holds good as long as a breakdown occurs within, say, a year from the time the machine has begun work, as then it is really possible to replace the damaged coils only. If, however, the machine has been working for a prolonged period, and working near its limit, it is found

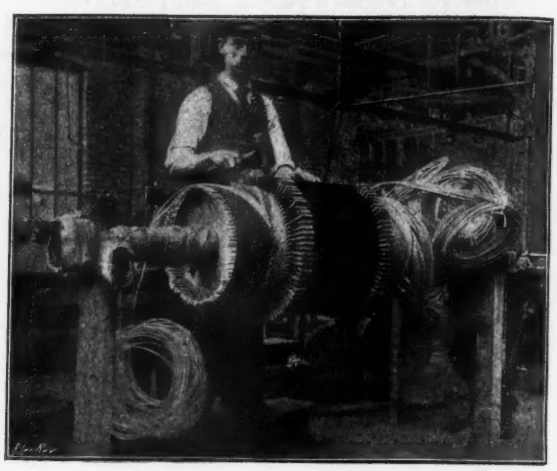


Fig. 15.

that when a breakdown occurs it becomes necessary to replace *all* the coils, because by that time the insulation has become so brittle that the disturbance caused by the removal of the faulty element damages its neighbours, and so on. As a matter of fact, it is the practice of quite a number of firms to simply strip an armature under those conditions, and provide it with new coils throughout without attempting partial repairs.

From this point of view, it follows that former-wound coils are only of distinct advantage in cases where the conditions of work are extremely severe, and may cause a breakdown within a few months from the start, however good

Fig. 16.

the insulation and workmanship may be; as an example we may mention all underground work, as in collieries, tramway work and the like.

The repairs on a hand-wound armature, if of a serious nature, require the services of an expert winder, and very often, although by no means always, as is generally supposed, necessitate total rewinding.

The writer's contention, however. is that a hand-wound armature is far less liable to break down than a formed coil, and this view is based on the fact that out of some 2,000 or 3,000 armatures of this description, of which he personally knows, not more than 2 to 3 per cent. have come back for repairs.

Somewhat cheaper labour is employed for former-wound armatures than for hand-wound ones, and once the coil is taped it is beyond control, although still to be manipulated, whereas the individual wires in the hand-wound style are under easy observation until the very last. The transformer test usually applied to the armatures before connecting to the commutator need not, and does not, necessarily disclose all defects; these might easily be of such a nature as only to become troublesome after the machine had for some time been exposed to vibration.

Electrically, the hand-wound armature is far superior; for the same space factor in the slots it allows of sounder insulation, or requires less room for the same insulation resistance as the formed coil; the gain in space is further increased by the fact that, in order to make the former coil at all successful, it is necessary to arrange for it to fit into place with as much ease as may be, but even under such conditions a considerable amount of detrimental strain is put on the coil when getting it into position and after its elements are beyond control. Neither is it possible when using former-wound coils to help commutation by suitably adjusting the reluctance of the magnetic path around individual coils, a point to be considered later, nor is it possible to secure uniformity of commutation for successive coils when the number of commutator sections is a multiple of the number of slots.

The natural result of all this is that a former wound machine, for equal performance, will be larger and heavier than a hand-wound one.

(*To be continued.*)

THE RAW RUBBER MARKET.

[FROM A CORRESPONDENT]

It would be entirely superfluous to tender the information that the price of raw rubber, and to a corresponding degree the price of manufactured rubber, is considerably higher than it was a year ago. The fact has been sufficiently brought home to all those immediately concerned and needs no emphasis. The inquirer, however, who endeavours to get at the why and wherefore of the situation which has arisen is likely, and not unnaturally, to be somewhat baffled by the vague and conflicting answers given to his questions. Therefore, although we must strenuously disclaim any intimate knowledge of the wheels within wheels which have acted as dominant factors in bringing about the rise in price, it may not be superfluous to make a few general remarks on the subject.

The prevailing idea that speculation on the part of a few individuals has done as much or more than anything else to run up the price may be dismissed as having very little foundation. True, there is a certain important firm of raw rubber merchants who are credited rightly or wrongly with holding stock to such an extent as to rule the market, and to render futile the efforts of competitors to control any action they may see fit to take. But whether this be so or not we are certainly not inclined to ascribe to this firm the fact that rubber reached such a high price two months ago. That the firm in question have profited by the situation can hardly be doubted; to say that they created it is, however, far too bold a statement to make. We say this not only because we lack proofs, but because there are other and good reasons to look elsewhere for the determining factor or factors. The employment of rubber has shown a continual increase, and though the output of raw rubber from the Amazonian forests has also increased, it has only been about in proportion to the demand, so that there has been no accumulation of stock to meet any sudden disparity between demand and supply. There is no need to discuss the question of any failure of supply in South America at all events. There is plenty of rubber yet, but in order to keep the price down, it is necessary that sufficient be gathered at the time it is wanted.

This sounds like an obvious truism, but it is inserted for the sake of clearness. The crop of last season did not come up to expectation owing, no doubt, a good deal to the troubles in the Acre district. At the same time the demand had grown, especially in America, where factories had a very busy year, and it was only to be expected, therefore, that stocks would become depleted with the inevitable consequence of a rise in price. Now that the political troubles in the Acre district have been settled, for the present at all events, there is every reason to anticipate a considerably increased production over that of last season, and the arrival of the new crop has already, as we write, begun to have its natural effect, a drop of about 8d. a lb. having already occurred. We do not feel in the least inclined to take up the *rôle* of prophet and say how far this drop is likely to prove permanent, or how far it has been brought about by diminished buying on the part of manufacturers. That trade has suffered during the last two months there is no doubt. Manufacturers naturally were chary of buying at the high figures prevailing further than was necessary to complete contracts in hand; buyers of rubber goods, moreover, held back until they could fill their requirements at a more reasonable figure. The result has been a slackness in trade, and it is quite on the cards that stocks of rubber held in quarters not generally known were unearthed for disposal before further arrivals of the new crop threatened a weaker market for the seller. But this is mere speculation and merits only the limited attention attaching to such.

With the advent of lower prices there can be little doubt that the consumption of rubber will increase; the motor tire industry absorbs an increasing amount; the mackintosh trade has take a new lease of life after a lengthy period of depression, and the rubber insulated cable is by no means in so moribund a condition as we are led in some quarters to believe. Altogether, the prospects of the industry may be considered good, and this must have an adverse influence upon the return of Para rubber to the neighbourhood of 3s. per lb., a price which the manufacturers consider essential for the due development of their trade.

To pass on to a mention of other than the fine Para of South America, which, as is well known, is the best quality of rubber produced, we find some altered conditions with regard to Africa which cannot be passed over as unimportant. There is an undoubted decrease of yield in some districts, several sorts which 10 years ago were familiar at Liverpool now hardly figuring at all in the market. This must be ascribed to the inevitable consequence of ruthlessness in collection, large districts having had their trees destroyed with the object of immediate profits without any thought being taken for the future. We are not going to enter into the current political question of the administration of the Congo Free State; the fact, however, that the supplies from this source have of late shown a diminution may be noted, though it should also be said that regulations as to the re-planting of denuded areas have been drawn up in obedience to commercial instinct, which is not averse to taking thought for the future. The reduction of African supplies, coinciding closely with the recent situation in South America, has naturally had some effect on the hardening of prices all round.

With regard to the prices of the different African brands, it is rather an interesting point that of late these have, to some extent, ceased to be regulated by the current price of Para rubber. Generally speaking, in the past all other rubbers as derived from Africa, Central America, India, in fact, from the rubber-producing zone throughout the equatorial regions, have had their prices fixed according to the ruling quotations for Para; now, however, there is to be noticed a disposition to buy these other brands on their merits without reference to the Para market. This latter can then no longer be said as of yore to regulate quotations generally, and the change is one that cannot fail to be advantageous to both buyer and seller. No doubt it was the high price of Para rubber a few years ago which set the manufacturer to work to see to what extent he could get along without it, and though the discovery that African rubbers were of more utility than previously recognised, may have, to some extent, led to the increased supply and the present diminished output, there does not seem any reason to suppose that the present state of affairs will prove permanent, and we are inclined to this opinion not only because of the considerable areas of forest which yet remain to be tapped, but also because there is abundant evidence that the destructive methods of the past will no longer be tolerated wherever it is possible to prevent them.

Laws and regulations concerning the working of rubber forests, are being very generally made, though, unfortunately, the fact of their existence is no indication of their observance. It will easily be recognised that in the untrodden grounds over which the native roams in quest of rubber the difficulty of effective supervision is great indeed, and it need therefore cause no surprise that in many cases the well-meant efforts of local authorities have

proved entirely negative in their results. Still it is matter for congratulation that the principle of conservation is now so generally recognised, and no doubt the difficulties of police supervision will tend to evanescence as time rolls on. It may be asked, to turn now to another issue, what effect have the rubber plantations, of which so much has been heard in recent years, had upon the supply and the price of rubber. To answer this query concisely in the brief space left at our disposal, we may say that as yet the plantation rubber cannot be credited with having had any real influence on the market. The amounts produced so far have been but trifling compared with the product of untended nature, and although the results so far achieved, more especially in the case of Para rubber at Ceylon, are extremely promising, it is still too early to speak with any great degree of confidence as to the prospects of rubber planting generally as a remunerative industry.

In conclusion, these observations are no doubt open to the charge of discursiveness and superficiality, and the writer's defence must be that having set out without any definite scheme of treatment before him, he has allowed himself to touch on various phases of the rubber supply question as they presented themselves to his mind's eye. Each of these phases might easily, it is recognised, form themes for separate treatment, but in pages more particularly devoted to such topics.

THE LEGAL POSITION OF THE CONSULTING ENGINEER.

[FROM OUR LEGAL CONTRIBUTOR.]

We have frequently touched upon a question which is of the greatest importance to electrical contractors, namely, the position and duties of the engineer who is to act as a referee in case of need when disputes arise between contractor and employer. It may be of interest if we state, in as few words as possible, the legal effect of the appointment of engineer.

In effect, his position is that of an arbitrator appointed by one side, if, indeed, the term "arbitrator" can be applied to any person occupying such an anomalous position. Persons are in the habit of referring to arbitration disputes which in the ordinary course would be settled in a court of law by one of the judges of the land. The consulting engineer occupies the position (however invidious it may be) of a judge whose salary is paid by one of the litigants before him, and who, however free he may be from anything of bias, cannot, in all human probability, be expected to always decide against those who employ him. It is no fault of the consulting engineer that he occupies this position; his salary must be paid by some one. The difficulty has arisen owing to contractors not being strong enough to resist the insertion in their columns of a clause which binds them hand and foot.

As a rule, where parties wish to oust the jurisdiction of the Court for the settlement of disputes, a clause is inserted in the agreement providing that, in the event of a dispute arising, it shall be competent for either party to appoint an arbitrator, and for the arbitrators so appointed to select an umpire. In such a case, if the two arbitrators disagree, the points upon which they fail to see eye to eye are referred to the umpire, whose decision is final. It will be seen that this form of arbitration is absolutely fair, inasmuch as the umpire is agreed upon by the arbitrators.

The Court is strongly opposed to any agreement which enables one party to appoint the arbitrator. In the case of *re* Frankenburg and the Security Co., 10 T.L.R., 393, an insurance company against burglary nominated their own manager to arbitrate under a policy containing an arbitration clause which left them to nominate the arbitrator. The Court held that such a proposal was monstrous, and gave them seven days to appoint another arbitrator, or in default ordered rescisson of the submission.

In view of the fact that the contractor is often bound hand and foot by the decision of the engineer, it is surprising that there is no combined effort on the part of contractors to insist that, in addition to a clause leaving the decision of certain points to the engineer, there shall be an arbitration clause. It has been proved in a number of cases (both Colonial and English) that the presence of such a clause is of the greatest assistance to the contractors, and that it prevents their being subject to the arbitrary decision and caprice of the engineer in all cases.

A contract for the sale of locomotives provided for payment of the price upon the certificate of the engineer that the locomotives were in perfect working order at Croydon, and it was further provided as follows:—"Clause 9. The vendors guarantee to make good any failure of the locomotive or boilers, as regards each locomotive or boiler, for a space of six months after the date of the delivery of the same if arising from bad materials, faulty workmanship, or from the system of construction of the engines." There was also an arbitration clause:—"All disputes to be settled by the engineer to the purchasers, and the engineer to be appointed by the vendors or their umpire in case of difference." The locomotives were delivered at Croydon, but the engineer refused to certify, or to give his reasons for not certifying. The vendors thereupon proceeded under the arbitration clause, the purchasers taking part under protest. An award was given in favour of the vendors. It was decided that a dispute had arisen within the meaning of the arbitration clause.

In another case—McDonnell *v.* Canada Southern Railway Co., (1872), 33 Up. Can., Q.B. 313—a railway contract contained a time clause, and a forfeiture for default clause, and an arbitration clause. It was decided that the engineer had no power to decide conclusively whether the plaintiff's (the builder's) delay of which he complained was caused by the defendants' acts and omissions, and that it was still open to the plaintiff to prove that it was so caused, before the arbitrator, as an answer to a plea setting up a determination of the contract by the defendants' engineer under the provision; and, further, that the reasonableness of the time given by the engineer by his notice was not a matter for him conclusively to determine, but was open to the consideration of the arbitrator.

The recent case of Foster & Dicksee *v.* Mayor, &c., of Hastings (19 T.L.R., 204) makes it plain that if an arbitration clause is inserted in a contract, the jurisdiction of the engineer to act as sole arbitrator may be ousted. In that case the plaintiffs were under contract to carry out certain works for the defendant Corporation. There was a clause providing that, if any dispute should arise between the Council or the engineer and the contractor as to the mode of carrying out the work or the interpretation of the contract or otherwise in relation thereto, or in settlement of the account, the same should be referred to two arbitrators, subject to the provisions of the Arbitration Act, 1889. The contract also contained a clause to the effect that if, in the judgment of the engineer, the work is improperly conducted, or sufficient dispatch is not used about it, the Council or the engineer should have the power, without prejudice to the contract, to dismiss the contractor and his workmen after giving a certain length of notice. Delay having arisen which rendered it desirable for the contractors to be dismissed, the engineer gave the necessary notices. The contractors, however, resented this treatment, and applied to the Court for an injunction, arguing that it was not competent for their employers to dismiss them in this summary way. A judge of the Chancery Division, who tried the case, held that the arbitration clause overrode the authority of the engineer, and that the question whether the contractors had been guilty of undue delay was to be settled by arbitration.

A study of the above cases will have shown that, by the exercise of a little determination, the power of the engineer as sole arbitrator may be considerably modified.

Unless such a clause is insisted upon, the contractor is virtually powerless, for where an engineer is employed on account of his skill or professional knowledge as *quasi* arbitrator, valuer, or dispute preventer, to value or determine some point between two or more parties, he is not liable in that capacity for want of skill, ignorance of law or negligence. The only case in which he is liable is when he is guilty of fraud. So in a case which was heard in 1875, one A agreed with B to lay a cable, the cable to be paid for by a sum payable when the cable was begun, and by twelve instalments payable on the certificates by B's engineer, who

was named in the contract. Shortly afterwards, this engineer, who was engaged to lay cables for A, agreed with A to lay this cable, also for a sum of money to be paid by instalments, payable by A when they received the instalments from B. It was decided that the agreement between the engineer and A was a fraud, which entitled B to have their contract rescinded, and to receive back the money which they had paid under the contract.

It sometimes happens that parties agree to refer matters in dispute to an arbitrator appointed by the president of one of the Institutes. In such a case, if the first arbitrator so appointed goes abroad, it is apparently competent for the president to appoint another in his place. So, where a submission provided for the appointment of an arbitrator by the President of the Institution of Civil Engineers, and the arbitrator appointed went abroad, and a second arbitrator was appointed in his place, but objected to act unless appointed by an order, the judge in Chambers made the order, which the Divisional Court rescinded as having been made without jurisdiction. The Court of Appeal upheld the Divisional Court, but refused to set aside the award of the second arbitrator, holding that though the order appointing him was bad, his appointment by the President of the Institution of Civil Engineers was a valid authority to act.

THE "NOMINAL" HORSE-POWER MAN.

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

THERE is one thing the writer envies the coming generation of engineers, and that is they will have much more intelligent customers and clients to deal with. For example, the time which electrical engineers of this generation have spent in wrestling with managers and so-called engineers on the advantages of electric driving won't bear thinking about.

Of all others, the mining or the works manager who thinks in *nominal* horse-power is about the most hopeless, because he has that little knowledge which, according to the proverb, is such a dangerous thing. It is not *so* much fiscal reform which the country appears to require as a benevolent Act of Parliament to retire on a pension all those managers and so-called engineers who *think in nominal* horse-power, and are not yet quite certain whether the electric motor will *really* reverse or drag a load out of a hole, or do the thousand and one things we know it is capable of. In his time the writer has done a very considerable amount of estimating for electric driving of works and mines, &c., and, although it seems a hard thing to say, he has seldom met with a man at the *head* of affairs who was really able to properly appreciate the problem. How they manage to get into their positions is a puzzle, for even in an ordinary commercial argument they can seldom see further than their nose. It is from such men one is given data in *nominal* horse-power, and if there was no other reason, the ignorance about their own machinery is quite enough in itself to call for a complete change of method.

In the writer's experience, the more crude the information supplied the more wasteful the system in use, and in the majority of cases the only way for the electrical engineer to actually find out what is being done is to couple an electric motor to each of the various machines and take readings. In time we shall have accumulated a quantity of such accurate data and be independent of the *nominal* horse-power man.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

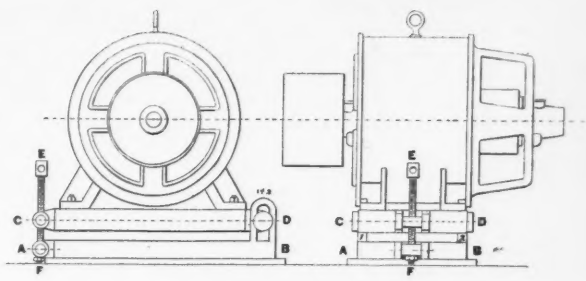
Device for Tightening Vertical Belt.

I should be much obliged if you could spare me room in your valuable columns for the opinions of your readers and yourselves on a new (?) application of the idea of the slide rail for belt tightening purposes.

At the works here, where I am electrical engineer, it was necessary, owing to travelling cranes, &c., to adopt almost vertical drives, so, in order to take up the stretch of the belts, the motors, which are 20 H.P. for driving shafting, were mounted on an article, a drawing of which is given below.

A B is a fixed casting, fixed to the floor with foundation bolts, having cast on to it two slotted lugs 1 and 2.

C D is a similar casting, to which is bolted the motor. At D it is hinged to 1 and 2 by bolts which can be moved



up and down the slots in 1 and 2. At C are two lugs having a nut through which the screw E F passes, being fixed at F.

When the belt is first put on C D is fixed at the top of the lugs, then the motor is levelled by screw E F, and as belt stretches C D is lowered (at one end), and when it is in contact with A B and more adjustment is required, C D is lowered at the slotted lugs 1 and 2. This is not my design, and, personally, I think it is far from desirable, and am inclined to think in time the nut at C will wear loose in the lug, and also the screw wear loose in the nut and other like parts, thus causing the motor to vibrate.

H. J. Kitchen.

Hebden Bridge, *November 24th*, 1903.

Fair Trade?

There are many interesting questions touched upon in the letter signed "Fiscaliteur"; the inability of "old-established works" turning out three-phase motors with doubts as to their designers; the virtue of "Fiscaliteur's" German firm in not "indulging in dumping," their happy position in being able to quote "at a fair price"; and the lamentable carelessness of the "friends in the Fatherland" (no, Mr. Editor, I won't use those naughty words, salesmen may, but engineers never do), in forgetting such little circumstantial details as *proper* name plates. All these are interesting, not to say instructive, but the most interesting facts brought out in the letter are those touching—let us say certain kinds of—"British finish," which, according to the writer, consists in the attachment to a wholly German motor of a British firm's (very old-established) name plate, which act, according to "Fiscaliteur," the British firm consider sufficient to entitle them to sell the machine as of "British manufacture" to a patriotic buyer, who thinks that by obtaining the goods from the "old-established firm" he is supporting British manufacture; I say nothing about the £100 factor, the buyer might have "another story."

Now, leaving for a moment the humdrum triphase motor, let us turn to somewhat similar phenomena in the higher walks of life. Then let

a = electrical engineer (out of a job, but with credit).
B = a grocer.
C = a given quantity of butter.
D = the majesty of the law.
x = a minus quantity.

Now, if the E.E. orders from B one pound of butter, and gets it, but finds that the paper wrapping has been counted as butter too (I. $B - A = C - x$) he invokes D, if he can raise 6s. 8d., the usual cost of legal proceedings in this country, which is fixed at this low sum, so that rich and poor can equally enjoy it; then D comes down on B $\left(\text{II.}\ \frac{D}{B}\right)$, but instead of the majesty of the law being lessened or divided as might be supposed by the equation (II.), its power is

increased, let us say in such an important matter as butter, $D^{1\cdot5}$ (it is well known that D can be never squared in this country), and, therefore, it is obviously the grocer (B) who suffers, mulcted, if I may be allowed to use the only legal term I thoroughly understand.

Now, substituting for E.E., a patriot, and letting B = an old-established British firm, C = a British triphase motor, D = majesty of the law, as before, and x = a name plate of British manufacture (perhaps), what result would obtain if the equation $\frac{D}{B}$ was again effected, *if* (yes, we are all allowed an "if" in the highest mathematics)—

$2 + 2 = 4$ = mathematics.
$2 + 2 = x$ = higher mathematics.
$2 + 2$ = anything you like = highest mathematics.

If it could be proved that $C + x$ did not even equal C by itself, but was a good deal less, $100 - x$ per cent., in fact. If a high-class grocer can be "mulcted" for so important a matter as $\frac{1}{4}$ oz. of butter, what ought to be done to a scoundrel of a manufacturer who palms off—— but no, I am getting excited; I cannot contemplate the picture; calmly speaking, I would suggest boiling oil; or, perhaps, it would be more professional to say an insulating compound of sufficiently low boiling point to act slowly.

It might be objected that it would be difficult to prove, and that D could not stop such practices; perhaps not; but an *ad valorem* duty of 45 per cent., or so, would, and quickly, too; and if "Fiscaliteur" really *wants* such things to stop, let him adopt the views of Mr. Chamberlain, and well another who is bashful, and does not like publicity.

R.M.I.E.E.D.

Technical Instruction.

"Absurd" ejaculates, with supreme contempt, your correspondent, Mr. W. L. Turner. But surely I can ask with ordinary modesty for convincing evidence that I stand convicted of absurdity. I am quite sure that a re-perusal of my letter will reveal a meaning that entitles me at once to enter a plea of not guilty.

Firstly, I did not say that "all," but "most," technical instruction in this country was a farce. Secondly, nor yet did I say that the half workshop, half university-trained man was unqualified to hold the position of technical instructor.

Now, sir, one intelligent reading of your correspondent's letter makes it self-evident that it is a defence of the very type of instructor whose shortcomings are apparent, at sight, to all the first year's workshop apprentices who attend evening technical school. Yet, if technical training is to rank as one of those progressive forces which count for the very kind of efficiency that is to enable us, as a nation, to fight our life and death struggle for commercial existence, *not supremacy*, the exclusively technical college graduate had better keep to his book, and leave practical instruction to practical men. It is not in the nature of things that he should possess the essential qualification that can alone be acquired by actual experience in modern up-to-date engineering workshops, when one calls to mind the fact that the average time spent by engineering students in actual practice is seldom more than two hours per week, and then in groups so large that the machines are operated by crowds.

If Mr. Turner would like to know what real technical instructors are like, I would advise a personal visit to some of the technical schools in Germany, Belgium and Switzerland; and if he has time, he might also run over to the Massachusetts, U.S.A., Institute of Technology, Boston. He will then see that pure science and applied science have values and places peculiarly their own. He will also see that considerable attention is paid to the developing of mechanical means for increasing, as well as cheapening, output; and it is here where the technical school man scores. This, I take it, is (or should be to give technical training its proper definition) the final purpose of a pre-eminently useful, as well as absolutely necessary, part of the nation's education.

Now, with regard to the teaching of pure science, let me ask, with all due respect to Mr. Turner, what earthly help would it be to the electrical branch of our commercial system if our technical schools turned out Dr. Hopkinsons by the thousand? As far as I am able to judge, only one Dr. Hopkinson was necessary, and we have had him with us, so that until the true nature of radium reveals new laws upon heat, I think we can reasonably say that for the present 10,000 similar scientific giants would not be able to raise profitably, from a commercial point of view, the thermal limit of output of a modern dynamo by half-a-dozen degrees Centigrade, and how much further, I would ask, is it possible to improve the calorific value of fuels by the scientific application of known laws? Who, may I again ask, are most valuable to a progressive commercial nation? Your Edisons, Maxims, Bells, Carnegies, Stephensons, Watts and Fultons, &c., or your pure science men? Yet had these men been crammed with physics in the orthodox mode, they would have been confined to grooves so hard and fast, and so narrow, that the world would never have seen their mechanical ideas put into practical shape.

In conclusion, I would say that I hold no brief for the abolition of technical schools, but I hold most strongly to the fixed belief that your modern technological institute graduate, minus at least five years of up-to-date workshop training, as a technical instructor has a negative value.

Arc.

[The need of properly-qualified technical instructors cannot be disputed; but neither can the importance of pure science be ignored. The electrical engineering industry is based wholly upon pure science, and ought to be the very last to repudiate its indebtedness to physicists such as, for example, Faraday, Maxwell and Kelvin, and the many other intellectual giants whose researches bear fruit to this day.—Eds. Elec. Rev.]

Re Walsall Switches.

In regard to the article on main switches manufactured by the Walsall Electrical Co., we should like to point out to readers of the Electrical Review that this type of switch, with its special feature in the adjusting arrangement placed between the laminated brush, has been made by us for some time. We were the original makers of this type of adjustment.

Richardson & Co.

Manchester, *December 5th*, 1903.

The Design of Variable Speed Motors.

Mr. Hobart's article in yours of December 4th, with reference to variable speed machines, is of great interest. In two points, however, I cannot agree with his paper. He states that the commutation of a machine depends upon the reactance voltage. He omits any reference to any other factor. He omits a very important point in connection with commutation, namely, field distortion. This field distortion varies with the strength of armature and with the strength of field. With a given strength of armature the weaker the field, the greater the distortion. Consequently, a machine may run perfectly well with a strong field, and the brushes in a certain position, but at high speed, with a sufficiently weakened field, brush shifting will be necessary; not in order to use the reverse field, but in order to avoid the distorted field.

A variable speed machine must be designed with an especially weak armature in order to minimise this distortion and to work with fixed point of commutation. This means an exceptionally expensive machine.

If field distortion should have nothing to do with commutation it is still more difficult to follow Mr. Hobart's paper. For a given machine at a given output the reactance voltage depends upon the speed of the machine, using Mr. Hobart's own formula.

As I understand, he proposes for a variable speed machine, speed range 2 to 1, to take the cheapest machine which can be built to deliver this output at the lowest speed.

If the commutation depends only upon the reactance voltage, the cheapest machine will usually be the one in which the reactance voltage at this low speed has been pushed up to the limit. Such a machine, if run at all above the minimum speed, will spark. We find ourselves driven to the conclusion which he declares we have avoided, namely, that the machine

must be designed to carry, without sparking, double the load at the low speed.

It is probable that to a great extent my disagreement with the writer is based on misunderstanding. To a certain extent he is correct. The amount of field distortion is limited.

If the armature strength is especially weak a fixed point of commutation may be found for any speed. A motor with a speed range of 3 to 1 can usually be built about as cheaply as one with a 2 to 1 range. But a motor with a 2 to 1 range of speed is much more expensive than one which will deliver the full load at the lowest speed.

J. N. Dodd.

Preston, *December 7th*, 1903.

Electric Shocks on Flat-Back Switchboards.

The arguments put forward in your last issue by Mr. Percy B. Hall, in favour of flat-back switchboards for H.T. work, when viewed in the light of actual experience, will not carry much weight with them.

While it is certainly very useful at times to have a clear passage-way round your switch gear, affording free facilities for inspection and repairs, the first consideration in the design of at least H.T. gear, is surely that of protection of human life, and I contend that it is these very facilities (which, by the way, are in too many cases only apparent) which constitute the danger, the chamber at the back far too often proving the execution chamber of the would-be inspector or repairer.

Mr. Hall mentions that only authorised and competent persons should have access to this chamber; but that unauthorised and incompetent persons can and do obtain access is a fact which must be taken into consideration by the designer. Moreover, it is not by any means the unauthorised or the incompetent men only who fall victims to the flat-back H.T. board, for it has been amply illustrated, if such illustration were necessary, that, no matter how experienced the operator may be, the chances of his stumbling against live parts, or instinctively clutching them to save himself from falling, or the liability of his making a fatal blunder among the maze of connections which generally exists at the back, are ever present.

I think, therefore, that the necessary isolating and partial dismantling of that part of the cellular board which it is required to inspect or repair, constitutes in itself one of its principal advantages, on the basis that the paramount consideration is the safety of the operator. Further, this isolating and partial dismantling need present no difficulties. With a simple arrangement of plugs or links any number of panels can be quickly isolated, and the partial dismantling generally consists in the simple withdrawing of a few of the insulating division pieces from between the panels or "cells."

Regarding the great number of H.T. switchboards of their well-known type, which have been installed by Messrs. Ferranti, Ltd., I believe it is a fact that not a single fatal accident, or, indeed, any accident worth mentioning, has yet occurred in connection with the working of the same. Thi record is, I believe, directly attributable to their persistent use of the cellular type of board with its inherent safety, as advocated by "H. W. C."

P. B. Aimer.

Manchester, *December 5th*, 1903.

Variable-Speed Continuous Current Motors.

I can hardly allow Mr. Frank Broadbent's statement as to double-rolling of a printing machine to pass without comment. After an almost daily contact for over six years with printing machinery, electrically driven, I am sorry that, although agreeing with his statement as to the speed range of 2 to 1 in a motor meeting most cases, I cannot agree that one speed is most suitable for *printing machinery*.

May I point out that his remarks only apply to machines known as one-siders, and are not applicable to either perfectors or rotary presses, and even with the two-revolution one-siders, there is no method of double-rolling other than tripping the cylinder.

The average range of speed for a one-sider (quad crown or quad royal), to enable the printer to obtain the highest output in the shortest time on any job, from finest three-colour work to plain bill-heads, should be from 900 to 1,800 sheets per hour; but the speed which would be most used on this machine would be about 1,500, and the 90 per cent. of the jobs would be run at this speed on high-class machines in an ordinary printing office. Circumstances alter cases, but even if a machine is used for one class of work, it would be beneficial to be able to vary the speed to meet the varying conditions of this work.

Take, for instance, the case of one-sided machines used for three-colour work or for the printing of loose formes—*i.e.*, posters, catalogues, or price-lists. To obtain the best results the speeds should be dropped from the average to allow a steadier travel of machine. Surely Mr. Broadbent would not suggest that they should be double-rolled, thus *restricting* the output for the day's work by one-half without actually driving the machines one revolution the slower? At the same time the conditions as to charges on plant, cost of power, wages, and actual wear and tear would remain the same.

With regard to the perfecting machine, it is impossible to double-roll, as anybody who has a knowledge of these machines knows full well. The average range of speed regulation should be from 1,000 to 1,800 sheets per hour, the majority of work on these machines being at from 1,200 to 1,400.

In the case of a rotary the conditions are again changed, and speed regulation is required over a much larger range than in either of the other cases. Double-rolling is again impossible.

The majority of rotary printing machines at the present day are combined with other machines, such as cutting, folding and stitching, and cannot be considered as simple printing machines, but here the special systems come into requisition.

The opinion in the case which Mr. Broadbent has cited, must have been given by one who had not been properly advised, or who had not had the time to personally gain the closer touch with the working of direct-current motors as applied to printing machines, that is absolutely necessary to enable anyone to obtain the highest all-round efficiency.

I shall have taken enough of your valuable space by now in pointing out that speed regulation cannot be economically obtained on *printing machines* by double rolling, although it might suit one manager to neglect the advantages offered of ease, of electrical control, and, therefore, saving of time and money, and to run his one-siders at one constant speed.

Frederick J. Thompson.

Stanley Road, Teddington,
December 7th, 1903.

The Multiple Supply System Patents.

I do not quite understand the letter from "Multiple Supply" in your last issue. He suggests, but is, apparently, careful not to state, that the details of my patent, No. 2,393 of 1903, were patented a long time before the date of my application. (Or does the expression, "all these details," refer to some other details which "Multiple Supply" has in his mind?) He says that if I refer to my patent I shall see that this is so. I may say that I have done so—not once, but many times—but without the result which he prophesies. If the details of my patent are indeed ancient history, I will, of course, make my bow and retire from the contest, only asking "Multiple Supply" to perform an act of courtesy to the vanquished foe, by saying when, or in what name, they were previously protected. I have examined a large number of traction patents, extending over several years, but without coming across any in the least resembling mine; nor have I found any suggestion of my arrangement in papers read before various institutions, or in the discussions thereon, so I must ask "Multiple Supply" to excuse my scepticism on the point.

C. H. R. Thorn.

London, S.W., *December 7th*, 1903.

Steam Turbo-Generating Plants.

As managing director of the Cambridge Electric Supply Co., Ltd., and also of the Scarborough Electric Supply Co., Ltd., and as, therefore, in some measure responsible for the

exclusive and continued use of steam turbines by these two concerns, I feel called on to draw attention to what appears to me to be the entirely misleading nature of the comparisons between the results obtained in steam turbine stations on the one hand, and reciprocating engine stations on the other, recently published in your columns by Mr. Alfred Morcom.

For his purpose Mr. Morcom states that he has selected reciprocating engine stations which are "under approximately similar circumstances as to costs of labour, fuel, output, &c.," as the turbine stations. No doubt he has made this selection as fairly as is possible; but, to show how unsuccessful he has been in this respect, it is only necessary to point out that among his reciprocating engine stations he has included Salisbury, where a portion of the electrical generation is carried on by means of water-power, and where both fuel and works costs are therefore abnormally low. Again, though Mr. Morcom specially mentions the matter of output, his own figures show an average annual output of 1,464,907 units for his reciprocating stations, and only 738,924 units for the turbine stations—a ratio of practically 2 to 1.

How greatly the mere quantity of output affects results may be seen from the following figures, which show how the costs of fuel, &c., have decreased at Cambridge and at Scarborough, as the output has increased in the last seven years :—

	Total units sold.	Fuel.	Oil, waste and stores.	Works costs.	Total costs.
Cambridge.					
1895	150,510	1·98d.	·19d.	3·91d.	4·53d.
1902	419,005	·66d.	·14d.	1·57d.	2·40d.
Scarborough.					
1895	135,177	1·66d.	·12d.	3·47d.	4·36d.
1902	431,777	·85d.	·08d.	1·61d.	2·65d.

Incidentally, the above figures also go to show that the efficiency of steam turbines does not fall off with use as has been suggested in some quarters.

Another most important omission from Mr. Morcom's figures is any consideration of the question of load factor, which, as all station engineers are aware, has a greater effect upon costs than almost anything else. The following are the load factors of the turbine and reciprocating engine stations selected by Mr. Morcom for the same years that he has given the other costs :—

Steam turbines.		Reciprocating steam engines.	
Blackpool	14·32	Leeds	12·31
Newcastle district ...	13 67	Halifax	16·98
Cambridge	9·13	Bootle	28·44
Scarborough	9·34	Taunton	12·77
West Bromwich ...	9·27	Darwen	12·12
Morecambe	7·06	King's Lynn... ...	15·58
Melton Mowbray ...	11·11	Salisbury	11·49
Average ...	10·55	Average ...	15 67

As will be seen, the average load factor of the reciprocating stations is practically 50 per cent. better than that of the group of turbine stations.

To recapitulate, the following are the points to which I desire to draw attention :—(1) Among the reciprocating stations Mr. Morcom has selected there is one where, owing to the use of water-power, the results are abnormal. (2) The average output of the reciprocating stations Mr. Morcom has selected is about double that of the turbine stations. (3) The former have, on the average, a 50 per cent. better load factor than the latter. I think that most engineers will agree with me that, under these circumstances, Mr. Morcom's comparisons are of no value at all.

Lastly, I note that in Mr. Morcom's list of turbine stations he has left entirely out of account that belonging to the Newcastle-upon-Tyne Co., which, if I mistake not, is now almost entirely run by means of steam turbines. Would it surprise Mr. Morcom to learn, what I am informed on good authority is the fact, namely, that the works cost of this station are now less than half the most favourable similar figure of ·62d. per unit which Mr. Morcom gives for Leeds? Now, the cost of coal and labour at Newcastle and Leeds cannot differ very greatly, so this enormous difference must be due to matters of load factor and output, and probably also to some amount of superior economy in steam turbines over reciprocating engines.

A. A. Campbell Swinton.

66, Victoria Street, Westminster,
December 2nd, 1903.

My friend Mr. Morcom has given you a table, of which I fail to see the value. He compares steam turbines with Belliss engines in respect of the cost of coal per unit, but he omits to state the cost of coal per ton, the calorific value of the coal, the kind of boilers in which the coal was consumed, and the load factor of the station. Under these circumstances, it would seem to me to be almost as reasonable to saddle the dynamos with the differences of coal costs, and ignore the engines altogether.

Henry Lea.

Birmingham, *December 7th*, 1903.

I have read with very great interest the correspondence that has been appearing in your columns *re* the above, but I should like to draw Mr. Barker's attention to a statement made in his letter that the "Newcastle-on-Tyne station holds the record for lowest works costs per unit." I would draw his attention to the *Electrical Times* of November 19th, in which he will see that the Huddersfield traction station holds the record with works costs of ·36d. per unit, as against the ·38d. stated by Mr. Barker to be the record. The figure I have stated, viz., ·36d., is for last year, but I fully expect to surpass that in the current year, the year under review being one of reconstruction of roads, &c.

In conclusion, I should state that the plant in use here is: Two Musgrave engines of 550 H.P., and a Combe-Barbour set of 1,200 H.P., Mather & Platt and Greenwood & Batley generators, superheated steam being used.

H. N. Thomas,
General Manager and Engineer.

Huddersfield, *December 7th*, 1903.

A great deal has been said and written regarding fuel and other economies to be obtained by using steam turbines in preference to slow and high-speed reciprocating engines, all of which have been very interesting and instructive; but I think the subject should also be considered in connection with its boiler plant and condensing apparatus, both of which are important items in the equipment of a steam-driven installation.

From a careful analysis of turbine plants which are being constructed, I find the boiler-house equipment is quite as large or even larger than that of many recent stations where reciprocating engines are installed, whereas one would naturally suppose it to be quite the reverse. As an illustration I will take the case of the generating station now being erected at Chelsea for the District and other underground railways of London, a description of which appeared in last month's issue of the *Railway World*. In this station there are to be 10 turbo-generating sets each of 5,500-KW. capacity, the steam for each unit being generated by eight Babcock boilers with superheaters and economisers attached, each boiler and its accessories having 7,242 sq. ft. of heating surface, or a total of 59,392 sq. ft. for each turbine unit, equal to 10·8 sq. ft. per KW. This ratio of heating surface is greatly in excess of that in many of our generating stations where slow-speed engines are working with saturated steam and a vacuum much lower than that demanded by steam turbine builders. We are told that each of the above turbines will carry an overload of 50 per cent. for two hours at "practically the same steam consumption per KW.-hour," whereas we know this cannot be done by a slow-speed reciprocating engine.

When investigating this interesting subject I came across a report of the arbitration proceedings in connection with the electrification of the metropolitan lines, and here I find one firm of contractors proposed to instal slow-speed generating sets, each of 2,500 KW., the steam for each unit and its auxiliaries to be furnished by Babcock boilers, with a total heating surface of 20,000 sq. ft., or 8 sq. ft. of H.S. per KW., this being adjudicated by Mr. Chapman as being a first-class installation (*vide Engineering*, Vol. LXXII., page 659). In view of this, I am utterly at a loss to understand why his turbine plant should require 30 per cent. more heating surface per KW. It cannot possibly be on account of the auxiliary plant, for I find it is no greater in one case than the other, and we are all aware of the excellent steaming qualities of the Babcock boiler when kept clean and in good working order.

On making a comparison of the condensing apparatus attached to turbine and reciprocating engine sets, I find in some cases a greater number of pumps are necessary to maintain the requisite vacuum for the turbine, thereby increasing the cost. Does not the condensing plant occupy more space than the turbine itself, thus off-setting whatever gain there may be in the engine room; and, further, I am inclined to think the total cost of the condensing plant must in some cases be but little less than that of the turbine set, so that when compared with a first class high speed reciprocating engine, there can be scarcely any difference in the first cost of the plant, and from the correspondence in your columns, it appears that the economical gain is on the engine side.

Will some one enlighten us still further on this much-debated subject, as it must be instructive to many engineers as well as

A Student.

In reply to the bulk of Mr. Wilkinson's letter in your issue of December 4th, 1903, we need only refer to the previous correspondence. For the rest, we can assure Mr. Wilkinson that we have had a very large and satisfactory experience with high superheat in our reciprocating engines during recent years, and, as our customers know, have done a great deal of hard work in assisting to make the advantages of superheat practically possible.

We omitted Shipley, as we found that they were receiving steam gratis from the destructor works.

Mr. Wilkinson's suggestion that a trial should be made with the best examples of reciprocating engines and steam turbines, under ordinary central station conditions as to superheat and vacuum, is, in our opinion, a good one. The difficulty is to get such a prolonged trial made under impartial and useful conditions, but if any of the leading engineering associations are prepared to take the matter up in the interests of their members, we should be very pleased to lend an engine for the purpose.

Mr. H. Barker says that Mr. Parsons's table for vacuum effect in turbines is wrong. Possibly Mr. Barker is wrong. We used the table given in Mr. Wilkinson's paper to refute Mr. Wilkinson's conclusions, but the point is a fine one, and does not affect the position.

Mr. Barker in your issue of the 4th inst., and Mr. Campbell Swinton elsewhere, attacks the examples given by us to show the great inferiority of the steam turbine in actual work, and Mr. Barker constructs a table by inserting some excellent figures which he has obtained from the Newcastle-on-Tyne Co., to which Mr. Campbell Swinton also refers. We presume these figures are for the 12 months' work up to date, and are not yet available to the general public. But surely it is unfair to make such a comparison, as both these gentlemen must know very well that returns for the same period from the bulk of the reciprocating engine stations will show improvements, and possibly equally great improvements, as compared with the last published returns. We have, however, now obtained a copy of the Newcastle-on-Tyne return, and it is interesting to compare it with the return for about the same period of one of the best equipped and managed reciprocating engine stations, namely, Leeds. The figure given by Mr. Barker, viz., ·38, if correct, is for the station costs per unit generated, but all the figures for costs in the *Electrical Times* analysis are per unit sold. This is a very different matter, there being a difference of nearly 20 per cent. on the average between these figures.

The figures from the returns, and the chairman's speech, are as follows:—

	Total units sold.	Cost of production.
Newcastle-on-Tyne	5,011,300 ...	£12,587/5/8
Leeds	4,448,650 ...	£11,524/5/4

To this should be added the cost of distribution for Newcastle-on-Tyne to the extent of 2,412,318 units. Adding the above percentage for distribution to the Newcastle costs above, we get a figure of works cost ·706 for Newcastle, against ·62 for Leeds.

When it is taken into account that the Newcastle-on-Tyne load factor (which Mr. Barker takes care not to mention) is probably double that of Leeds, it will be apparent to the majority of electrical station engineers, that the Leeds results are much the better of the two. Moreover, a large portion of the work covered by the Newcastle return will have been done by reciprocating engines, about equal in power to the steam turbines, which latter have only recently been set fully at work in the station.

Mr. Barker's table, as it now stands, includes this unpublished semi-reciprocating engine station result on his own side, and drags in Yarmouth to compare with Scarborough to blacken the reciprocating engine record on the other. From the "Central Station Directory" we abstract the following:—

Yarmouth.—Welsh coal through and through used for fuel.

Scarborough.—Steam coal and smudge used for fuel.

and yet Mr. Barker objects to our use, in a general sense, of the word "quibbling"!! We were quite aware of the inequality in the load factors pointed out by Mr. Campbell Swinton, and surmised that it might be due to anxiety on the part of the turbine stations to hold a big margin of spare plant to meet the risks due to stripping of the blades and other difficulties inherent to their system. They appear, anyhow, to have been able to develop a special maximum power on some particular occasion considerably in excess of their average power, but the load factor, as calculated from the tables, has no very close bearing on the relative economies, as anyone can see by a careful study of the tables. For example, take the two stations, Cambridge and Scarborough, referred to in Mr. Campbell Swinton's table (in fact, he is the managing director of both). Cambridge has the smaller output and the smaller load factor, and, although it has probably to use as dear a coal as Scarborough, its consumption runs out to ·66 only, as compared with ·85 for Scarborough.

We took trouble with our table to put the matter reasonably fairly on both sides, and, as we have said before, we might have given 38 reciprocating engine stations showing an average of ·41 for fuel cost, instead of the seven selected stations with ·51 cost. There is, however, no reason for your readers to accept our table or that of any other interested person. At the cost of a few pence they can buy an electrical paper with the full tables in, to draw their own conclusions from. In doing so, we would ask them to bear in mind that steam turbines are at their best when new, and that there is a very quick limit to the possible improvement in the design of the steam turbine, though the machine itself is still very experimental. In this connection, Mr. Wilkinson's remark that "every steam turbine station in our list, except one, was at the time covered by the figures given, employing obsolete turbine plant," is a very ominous one, especially as our list included nearly all the stations using steam turbines. The clearance difficulty is very real, especially with plant under two or three thousand horse-power, and the experience with larger plant is very limited at present. The fact that two immensely wealthy American firms have adopted steam turbines as their standard for high speed running only shows that America has hitherto had no effective standard high-speed engines, and have probably assumed that in the steam turbine they will secure an engine capable of considerable improvement. They may very easily be mistaken. The two or three hundred thousand horse-power ordered only shows that these two firms have large financial control, and are able to secure orders. The wise man will wait till the experience comes.

In first cost, the temptation to take the steam turbine for large sizes is great, but in the end the machine may prove much more costly than the well tried reciprocating engine.

In conclusion, we can only say that if in the opinion of your readers we have argued too strongly in favour of the reciprocating engine, we have done it without any manufacturing bias, as we are prepared to build steam turbines of any size, as soon as we have determined that it is advisable in our own interests (which include satisfaction to our customers) to do so.

For **Belliss & Morcom, Ltd.**
Alfred Morcom, *Managing Director.*

Mr. Wilkinson states in his letter, published in your last issue, that "it is an undoubted fact that turbines give no trouble when working with superheated steam," and further on he mentions West Bromwich as a station where the turbine plant has the distinction of being not obsolete. Now, I have information that about a fortnight ago about one-fourth of the total number of blades were stripped off

one of the turbines at a station not very far from West Bromwich, that the trouble was attributed to superheated steam, and that the blades are to be replaced by others of a metal specially adapted to withstand the effects of superheat. I also know of the same thing having happened not long since at another station, the failure being again attributed to the use of superheated steam. At this station reciprocating engines were in use as well as steam turbines, and when, subsequently, extension sets were required, reciprocating engines were installed. I have also heard of the blades being stripped off a large turbine in the States, where superheated steam was in use.

These sort of experiences are not as a rule published in the papers—indeed, it seems almost indecent to drag them into light—but if, without any special sources of information, I have heard of three different instances of trouble with superheat, no doubt others have occurred which have not come to my knowledge.

Perhaps Mr. Wilkinson might say as to what experiences he has had with blades being stripped off the turbines at his station.

Reciprocating Engine.

The Fynn Patents.

We notice on p. 915 of your issue of the 4th inst., a paragraph which states that Messrs. Hodgson, Wright and Wood are the sole makers at present of machines under Fynn's patent.

To prevent misconception, we would suggest this company is the sole owner of the following patents, which were the property of the late firm of Rosling & Fynn :—

No.	Date.	Title.
468	7/1/98	Improvements relating to enclosed dynamos and motors.
4,932	15/3/00	Improvements in or connected with electric motors and generators and other electrical apparatus and instruments.
9,425	13/4/97	Improvements in electro-magnetic clutches or couplings.
8,227	3/5/00	Improvements in or connected with windings for dynamos, electric generators, motors and converters.
13,532	1/6/97	Improvements in winding for the armatures of direct-current dynamos and electric machines.
13,276	27/6/99	Improvements relating to enclosed dynamos and motors.
25,307	1/11/97	Improvements in or connected with drum armatures for dynamo-electric generators and motors.
27,995	27/11/97	Improvements in or connected with devices for protecting electric circuits and apparatus from injury by excessive electrical potential due to lightning or other cause.
24,472	20/12/95	Improvements in dynamo-electric machines.
		FOREIGN PATENTS.
840 (Russia)	31/5/98	Improvements in dynamo electric machines.
127,373 (German)	13/7/00	Patent for drum-winding for winding.
587,573 (U.S.A.)	3/8/97	Improvements in dynamo-electric machines.
305,037 (French)	2/11/00	Invention for windings for dynamos.
152,954 (Belgium)	3/11/00	Ditto.

Messrs. Hodgson, Wright & Wood bought the designs of some nine sizes of standard machines made under Fynn's patent, the sizes running to approximately 75 KW.

Anyone wishing to commence the manufacture of machines under the above patents will, of course, have to arrange terms with ourselves.

Phœnix Dynamo Manufacturing Co., Ltd.
FEARNS FEEARD, *Secretary.*

Bradford, *December 8th*, 1903.

Design of Direct Current Machinery.

I shall be very glad to give your correspondent, "Willing to Learn," my reasons for advocating the rotation of the commutator *against* the inclination of the brush; they are briefly as follows:—

Consider the case in fig. 1, where the commutator revolves *with* the inclination of the brush. It is obvious that the friction between the brush and the commutator will carry the former in the direction of arrow 1, and force it against the side *b* of the brush-holder, tending to wedge the brush tight between *b* and the commutator. The pressure of the spring transmitted by lever L not only keeps the brush down on the commutator but also presses it against *b*. If we remember that the success of the carbon brush depends, amongst other things, on its freedom of movement, *i.e.*, its ability to follow the irregularities of the commutator, we see

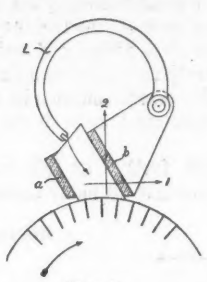


FIG. 1.

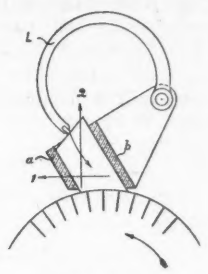


FIG 2.

that any attempt on its part to do so entails an upward movement in the direction of arrow 2, again increasing the pressure of the brush against this same side *b* of the holder. This freedom of movement depends, therefore, in this case to a greater extent on the quality of a surface *b*, than on the pressure spring.

In order to make it possible for such an arrangement to work at all, the friction coefficient between brush and *b* must be reduced to its least possible value, but how long could this minimum value be maintained in practical work?

It is also to be noted that in fig. 1 the brush when giving way to any irregularity must rise *against* it. My experience goes to show that the brush under these conditions is liable to stick and break away by degrees.

In cases where no special provision is made for taking the current from the brush to the holder, the greater part of it would, under those conditions, find its way to *b* quickly, roughing and disintegrating both contact surfaces and making matters still worse.

In fig. 2 the conditions are far more favourable. The friction between commutator and brush tends to force the latter against the side, *a*, of the holder. The lever, L, tends to keep the brush away from *a*, and that pressure is further relieved when the brush rises in order to follow irregularities of the commutator, it will also be noted that the brush in this case moves *away* from any obstacle it has to overcome.

There can, I think, be no doubt that the movements of the brush under these conditions are less hampered and more directly under the control provided for that purpose, namely, the lever, L, with its spring.

Val. A. Fynn.

Bradford, *December 7th*, 1903.

I have had a lot of experience with most types of carbon brushes, and quite agree with "Willing to Learn" that the carbon brush of the rectangular type with an inclination against the direction of rotation is not only noisy, but gives a lot of trouble to keep in order from its tendency to "hop" or vibrate on the commutator. There is also another type just as bad—"only worse." I refer to the carbon block sliding in a box, and trusting to a doubtful contact on the sides of the box to convey the current.

The best type of carbon brush gear, and the one that runs the most silent, smooth and cool, embodies the following points:—*Holder* or frame perfectly rigid, with no other movement other than that describing a circle round its point of attachment to brush arm. *Lead* for current to carbon block (or frame in which it is fixed), flexible and quite independent from frame itself. *Spring* adjustable from brush arm, and such that when a fair tension is on will follow up when $\frac{1}{4}$ in. of brush is worn away. *Position* on commutator such that a line drawn through centre of holder cuts the centre of brush arm and is parallel with a tangent from the commutator at the point of brush contact, and is little, if any, above the top surface of carbon block.

I have had holders made for machines containing these points that have run without attention for more than 12 months at a time, and with hardly any wear on the com-

mutator. They also have the advantage of being able to run as well in one direction as another.

Henry J. Robinson.

Handsworth, *December 8th*, 1903.

Heating Capacity of Electric Radiators.

We beg to inform you that since the publication of Messrs. Falk, Stadelmann & Co.'s letter in the last issue of the Electrical Review, they have kindly offered to supply us with one of their electric heaters for the purpose of making practical tests with it, and of convincing us that their statements in regard to heating capacity are correct.

It is evident from the correspondence which has taken place that Messrs. Falk, Stadelmann & Co. base their claims for the superiority of their heater—in respect of heating capacity—on some peculiarity in their design, and entirely ignore the oft-proved heat equivalent of electrical energy (962 calories = 1 watt-hour). For this reason it would, we think, be idle to pursue this controversy on purely theoretical considerations which obviously do not appeal to the vendors of the Phœnix heater.

We intend, therefore, making a number of practical tests with the heater which they are sending us, although we are well aware that the results obtained will only bear out your contention that the electrical efficiency of every non-luminous electric heater is the same. Some small variations in the results obtained are, of course, to be expected, due to the unavoidable differences in the conditions under which the tests are made.

We shall feel indebted to you if you will, after we have completed the tests we purpose making, afford us the opportunity of publishing the results in the columns of your journal.

The British Prometheus Co., Ltd.,
H. Skipwith, *Manager.*

[We shall await the results of our correspondents' tests with great interest, and shall have much pleasure in publishing the results, subject, of course, to the consent of Messrs. Falk, Stadelmann & Co. to this proceeding being obtained. —Eds. Elec. Rev.]

Waste of Energy in Tendering.

The letter of "X" in your last week's issue put very fairly and temperately the case from the opposite side to that of the contractors and others who wrote earlier in the discussion, and shows the difficulty of finding any solution agreeable to all parties.

In advocating the practice of inviting, say, six tenders for any one job, I had in mind, of course, not municipal and similar contracts, which must go out to public tender, but the large class of installations for private clients.

When considering the letting of contracts for any work, every engineer of experience knows pretty well who are most likely to suit the special circumstances of the case, and can easily select a number of firms, all of whom will do the work equally well and for very nearly the same price. For another job, the characteristics of which are perhaps quite different, an entirely different set of contractors would, no doubt, be chosen, the choice depending on the nature of the work.

Theoretically, of course, both contracts might have been put up to open competition, but in that case the lowest tenderer who might have been the right man for the second job would probably not be the best one for the first, although his tender being the lowest, it would be difficult to pass him over.

The remedy is to invite tenders only from those whom you consider best fitted for the particular work in hand, in the same way that the client selects his engineer with due regard to the specific matter on which he requires advice.

In this way whilst seldom calling for many tenders for any one piece of work, the list of contractors asked to tender would be a fairly extensive one, and "X" need not fear, therefore, that there would be a "monopoly of six," and certainly not that these would be only the largest firms.

When a specification is clear and definite a small firm with its smaller standing charges is often in a much more favourable position in tendering than one of the large firms.

Other engineers inviting tenders would possibly select quite different firms, with the result that orders would be distributed pretty much as now, but far fewer tenders would be sent in and the standing charges, and therefore the cost of each job, would be reduced.

Handcock & Dykes.

Victoria Street, S.W.,
December 9th, 1903.

Electrical Contractors and Manufacturers.

We enclose copy of a letter received from Messrs. Rashleigh Phipps & Co. to-day, together with our reply to same; possibly the subject matter may be of sufficient interest for notice in the columns of your Journal.

We do not know to what extent you agree with the objects of the Associations referred to, but having regard to the remarks which you have published from time to time with reference to the methods and practices of various Trade Unions, we can only hope that you will condemn such an attempt at intimidation, and agree with us that it ought to be brought before the trade generally.

We ourselves decline to be dictated to in this manner, and we shall be glad to hear the views of other manufacturers who have doubtless received similar letters.

Ernest F. Moy, Ltd.
E. F. Moy, *Managing Director.*

Camden Town, N.W.
December 8th, 1903.

[copy.]

102, Oxford Street, W.
December 7th, 1903.

Messrs. Ernest F. Moy, Ltd.,
Greenland Place, Camden Town, N.W.

Dear Sirs,—By the terms of an agreement entered into between the National Electrical Contractors' Association and the National Electrical Manufacturers' Association, we hereby give you notice that, unless you are members of the National Manufacturers' Association on or before the 1st of January, 1904, we shall be unable to do business with you. We would therefore suggest that you put yourselves in communication with Mr. Davenport, the Secretary of the National Manufacturers' Association, whose address is Ridler Place, Holland Street, Blackfriars.

Awaiting your reply,

We remain, yours faithfully,
(Signed) Rashleigh Phipps & Co.

Greenland Place, Camden Town, N.W.
8th December, 1903.

Messrs. Rashleigh Phipps & Co.,
102, Oxford Street, W.

Dear Sirs,—We have to acknowledge receipt of your letter of yesterday's date, at the contents of which we desire to express our utter astonishment.

We believe that Mr. Phipps is one of the gentlemen responsible for the formation of the National Electrical Contractors' Association and also the National Electrical Manufacturers' Association. We presume that these are one and the same body, as the one association would be useless without the other, and we therefore consider that we are justified in regarding your letter as being a semi-official communication from these associations.

While we may be in sympathy with some of the objects of the Associations, we certainly cannot agree to join a combination which descends to such contemptible means to gain members to its ranks. The policy savours very much of the ordinary workman's trade union and coercion in its worst form, and while it may answer very well with a poor fellow who can only expect to be thrown out of work as a result of showing his independence, it will not answer when applied to business firms run by business men.

We have always done our best to merit your support by turning out substantial and reliable work; you certainly would not have continued to favour us with your orders had we not done so, and we shall be very sorry to lose you as customers.—Yours faithfully,

Ernest F. Moy, Ltd.

[Correspondence on the above matter is invited.—Eds. Elec. Rev.]

"Groundless Fears": A Protest.

With reference to your remarks *re* my letter, published by you and subscribed by you "Groundless Fears," I am sorry to see that my well-meant criticism, based upon facts, with reference to the fittings in the car I was travelling in between Lombard Street and the Angel, causes you to abuse me in a not very professional manner. My name should be well known enough by now in the electrical profession, after having been the engineering head of several large concerns in this country for over 15 years, as not to deserve the reproach of publishing a "*canard*."

I repeat, the fittings were alive.

I repeat that the attendant rushed at me when he saw me touching one, shouting: "Don't touch these fittings, or you will be knocked on the floor."

I repeat that the attendant informed me "that almost all the cars were in the same condition."

I further beg to say that your leader's statement as to having tested 400 "fittings," I am sure any experienced engineer will agree with me that such test, if it was carried out at all, would have necessitated the disconnecting of the fittings, and this would have taken a considerable number of days. You do not hit the point, however, as the fittings may be sound, though the leakage causing the shock would be caused by bad wiring; and it evidently never struck the expert you sent down to Clapham to examine and test this. I recommend, however, that this should be done.

As to correctness of the facts mentioned, I have asked Mr. John Lang, of 137, Fenchurch Street, to append his signature to this letter, as he was with me at the time of the journey, and took part in the conversation with the attendant.

G. E. Heyl-Dia.
John Lang.

[We must strongly deprecate the suggestion that we in any way abused our correspondent; if we spoke of his statement as a "*canard*" (*i.e.*, an "extravagant report," *vide* Webster), we by no means intended to apply the term, or the name of any other fowl, to himself. We quite agree, however, that Mr. Heyl-Dia's name is extremely well known in the electrical profession.

Mr. Heyl-Dia "repeats" what he did not say before—that the attendant rushed at him, and said that he would be knocked on the floor. We have proved to our complete satisfaction, and, we hope, to that of our readers, that this risk is purely imaginary. We quite fail to understand how one could test whether the fittings were "alive" after disconnecting them! We could doubtless then have tested their mechanical strength, their optical qualities, their weight and volume; our object, however, was simply to ascertain whether they were *alive*, and if so, whether a painful or even dangerous shock could be received by a passenger. To this end we touched the metal of each fitting with the naked hand. In only two cases did we receive any shock at all, and in those cases, although we knew that one, at least, was at or near the maximum potential above earth, the shock was not even painful.

As the lamps on these cars are wired five in series, short-circuits between the wires are impossible; any leakage from the wiring would be direct to earth, and would not charge the fittings. These can only come in contact with the conductors through the lampholders, or, as we have stated, through faulty lamp bases.

We do not dispute the accuracy of Mr. Heyl-Dia's premises; what we found fault with was his conclusions. We are of opinion, moreover, that whether these were right or wrong, he should have addressed himself in the first instance to the railway company, and not have rushed into print without affording the company the opportunity of investigating the matter, and, if necessary, rectifying the fault.—Eds. Elec. Rev.]

Municipal Problems.

As it happens, I have an inquiring mind and desire to know a small portion of the funny things said and done by the municipalities in the United Kingdom. Now, Sir, a case in point of inquiry is this. A month ago tram tenders came before the Brighton Town Council; and the Tramways Committee had decided to recommend the Council to accept a tender for tramcars in which the trucks were to be of American make, notwithstanding the fact that a firm was willing to supply the cars with British-made trucks at £230 lower than any other tender (I refer to the Brush Co.). A letter appeared in a local newspaper a day or two before the Council met, calling attention to this fact, with the result that the chairman of the Tramways Committee (Alderman Stafford) withdrew that part of the proceedings relating to the purchase of tramcars because a misunderstanding had got about the town.

This matter came up again before the Council last Thursday, and the Tramways Committee recommended that 10 cars be accepted from Dick, Kerr & Co., who supply American-made trucks, and 10 cars from the Brush Co.; but the latter was subject to cars being made with Brill trucks. Although their tender with English-made trucks was considerably lower than the other firms, the Council decided to have all the cars (20) from Dick, Kerr & Co., because it appears the engineer (Mr. Holliday) stated that he would not be responsible for the safe running of the cars with the Brush Co.'s trucks; this placed the Council in an awkward position, with the above result.

Now, Sir, what I want to know is this, Can tram trucks be made in England by British labour as reliable as those made in America? If so, our tramways engineer has no right to boycott the home-made article. If they cannot be made in England, than he was quite right. Perhaps some of your numerous readers can give me the information I require. One other point on this matter, Sir. During the discussion in the Council on these car tenders, Councillor Galleirs stated that he saw 50 cars in course of construction at the Brush Co.'s works for the London C.C., but was corrected by Alderman Stafford, who stated they were for the London United, and then asked Councillor Galleirs if the London United were in the Trust. Of course, Councillor Galleirs was indignant with Alderman Stafford, and retaliated by asking him something about the Reason Manufacturing Co. What the Trust and the Reason Manufacturing Co. have to do with the matter I do not know (should like to). Moral, if town councillors throw dirt across the Council chamber, they not mind if it is thrown outside.

There is another matter I can never understand; if a person advocate views which are not in accordance with a section of the community (Socialist), he is either in connection with the Industrial League or the British Traction Co. or the Trust. Now what the Trust is, as also the Industrial League, goodness knows, I don't; should like to. And the reason I ascribe the hatred of the B.E.T. Co. is because these gentlemen are all foreigners using a British name to hoodwink the public. Perhaps someone can tell me if I am right in my surmise.

Now, Sir, what with tram trucks made in America; rails, America, Germany and Belgium; telephones, Norway, and all the best work in this latter commodity fitted up by Norwegians, there will be nothing left for home workmen presently but unskilled labour. And as for that the Municipal Telephone Committee of the Brighton Town Council has been employing labourers at 4d. per hour, which is 1½d. lower than what they demand of a private trader if he has a contract to perform under the Town Council. Not only this, but these men are allowed 9d. per day expenses when out of town working, which is half the amount a private trader allows for out of town expenses.

One more word, Sir, and I have done. Whilst the political world is being stirred up by Free Trade, Retaliation and fiscal policies, I venture to state, without fear of contradiction, that the trade of this country at the present time and for the future rests more upon the actions of our great municipalities than any fiscal policy that Mr. Chamberlain or anyone else might bring forward. I am moved to write this letter to your journal, Sir, because I believe a great injustice is being done to my countrymen, and I feel sure, Sir, if we are given the chance, we can produce men and things in England as good, if not better, than out of it. As my letter contain some things which I can prove to the hilt, I shall not use my *nom de plume*, but sign myself

A. E. Hewett.

277, Ditchling Road, Brighton.

[We understand that the Brighton specification clearly called for Brill or Peckham trucks, and that every contractor was in this respect put upon an equal footing. The original recommendation of the Committee, so far as we can learn, was based on the lowest offer with Brill trucks. If an American truck is superior to a British truck, the question is then quite outside the fiscal consideration.—Eds. Elec. Rev.]

THE GERMAN ELECTRICAL INDUSTRY.

New Amalgamations Completed or in Progress.

There is now no longer any doubt that greater activity prevails in the German electrical engineering industry, the principal works being reported to have on hand at the present time considerably more orders than at the corresponding period of 1902. It is even said that prices are beginning to show a slight improvement, but no evidence is forthcoming to substantiate the statement. The surprise of the moment is the heavy loss incurred this year by the Union Electricity Co., to which reference will subsequently be made, but it is thought that the loss is due to extraordinary provision being made for depreciation with a view to the complete absorption of the company by the Allgemeine Elektricitäts Gesellschaft at an early date. If this should take place the amalgamation of the Austrian branch companies would doubtless speedily follow.

In the case of the Austrian branch of the Siemens & Halske Co. and the Austrian Schuckert Co., arrangements have already been completed for the combination of the two undertakings under the title of the Austrian Siemens-Schuckert Works Co., with a capital of 18,000,000 kronen, half of which will be provided by each concern. The cable factory, telephone and railway signalling departments of the Siemens Co. at Vienna will, however, not be included in the amalgamation, but will be continued as hitherto. The new company resulting from the fusion will then constitute the largest of its kind in Austria. Another amalgamation is that of the Bitterfeld Electro-chemical Co. and the Rheinfelden Electro-chemical Co., the former increasing its capital for the absorption of the latter. This combination is probably due to the action of the Zurich Bank for Electrical Enterprises, which controls the shares of both companies and in which the Allgemeine Elektricitäts Gesellschaft of Berlin has a large financial interest.

The board of supervision of the Allgemeine Elektricitäts Gesellshaft has just had placed before it the financial statements respecting both that company and the Union Electricity Co. In the case of the A.E.G., the figures, which relate to the twelve months ended with June, show, after deducting £140,632 for working expenses and taxes, and providing for interest on the bonds and for depreciation, net profits amounting to £281,219, as compared with £281,702 in the preceding year. The sum written off for depreciation is arranged on the same basis as in previous years, and the money or liquid means at the company's disposal exceeds £1,350,000, this being about identical with that existing a year ago. It is proposed to pay a dividend at the rate of 8 per cent., as in the year 1901-2. The number of orders received during the year has been greater, and the quantity has since then considerably increased. In the case of the Union Electricity Co. the statement only applies to the six months ended June 30th, 1903, as a result of the agreement with the A.E.G., and the decision to transfer the beginning of the financial year from January to July. The statement remarks that the six months do not show normal results, as the large tramway constructional works and deliveries are effected in the spring and summer, whereas the accounts affecting them only fall due in the autumn and the winter. In addition to this, considerable expenses have been incurred in the transfer of certain manufacturing and sale branches to the A.E.G., this being necessitated by the agreement providing for the division of work between the two companies; whilst, at the same time, it has been considered advisable to make extraordinary provision for depreciation and reserve, as a result of entering into the community of interests. In these circumstances the statement submits that a book loss was inevitable. It amounts to £127,496, according to the balance drawn at the end of June, and the loss is to be covered by the extraordinary and ordinary reserve funds. The book loss compares with a 4 per cent. dividend paid for 1902. The statement concludes by observing that the orders on hand for electric tramways are satisfactory.

The Berlin-Hagen Accumulator Works Co., which controls the Tudor type of secondary battery in Germany, proposes to absorb the undertaking of the Pollak Accumulator Co., of Frankfort-on-the-Main. Formed in 1894, the capital of the latter company was gradually increased to £100,000, and dividends were paid for several years, including 7 per cent. for 1900. It was, however, subsequently discovered that owing to an error in book-keeping, a profit, instead of a loss, had been shown for that year, and the amount distributed had to be refunded. The years 1901 and 1902 also resulted in considerable deficits, and the situation of affairs has now become aggravated by the amalgamations in the electrical industry, and particularly as a result of the loss of the Schuckert Co. as an important customer, and the recent loss of a portion of the orders hitherto placed by the Lahmeyer Co. In the case of the Schuckert Co., the combination formed with the Siemens & Halske Co. has had the effect of transferring the former's custom to the Berlin Accumulator Co., and as there is no prospect of an improvement in the position of the Pollak Co., it is proposed to amalgamate it with its Berlin rival, against which it is no longer possible to compete. Negotiations for this purpose have been proceeding during the past 18 months, and the Berlin company, which has a share capital of £312,500, is now acquiring all the shares in the Frankfort concern on the basis of the payment of £33 15s. for each £50 share. It is intended to liquidate the Pollak Co. on the completion of the transaction.

The Electric Light and Power Investment Co., of Berlin, which has a paid-up share capital amounting to £937,500 and a loan debt of £500,000, is a trust which is closely associated with the Siemens and Halske Co., and is consequently financially interested in undertakings or works promoted or carried out by the latter in Germany and other countries, as well as participating in other enterprises. During the year 1902-3 the investment company has succeeded in improving its position; the net profits from interest and dividends on shares and syndicate transactions amount to £59,460 as compared with £36,077 in the previous year, and it is proposed to pay a dividend at the rate of 5 per cent., as against 3 per cent. Among the company's investments may be mentioned the Underground Electric Railways Co., of London, in which the former has increased its holding from £10,000 to £20,000 by the acquisition of 5 per cent. profit-sharing notes.

The Cologne Co. for Electrical Investments may be remembered as having undergone both a complete financial reorganisation over a year ago and entire severance from the Helios Electrical Co., with which its relations were formerly those of a trust. As a result of the reconstitution, the Cologne Co. has a share capital of £500,00 which is equally divided into ordinary and preference shares. The report of the directors for 1902-3 states that at the beginning of the year the company took over the management of the several electricity works in which it is interested, and the working surplus has improved in a gratifying manner. Including the balance brought forward from the previous year, the sum available for disposal amounts to £28,074, and a dividend at the rate of 6 per cent. is to be paid on the preference shares, the ordinary capital not receiving any distribution.

The Carlsruhe Electrical Industry Co., which was subjected to a reorganisation of its finances early in 1902, emerged from the ordeal with an ordinary share capital of £30,000 and preference shares amounting to £40,000. Notwithstanding this, the year 1901-2 closed with a large loss, which was extinguished by drawing upon a special reserve fund, and the financial period ended last June has terminated with a further loss, which is also covered by the reserve fund, the latter now being reduced to £8,300. The company's report states that prices are depressed, but the turnover has considerably increased, and it is proposed to extend the works and to take up the construction of a steam turbine in which an interest has been gained.

THE WAGES OF TELEGRAPHISTS.

On Wednesday, November 18th, the Committee on Post Office Wages received evidence on behalf of the Central Telegraph Office. Sir Edward Bradford presided, and the whole of the members were present. The witnesses were Messrs. C. H. Garland and S. W. Belderson, and the joint statement of the case was submitted by the former. The following is a brief abstract of the evidence submitted:—

Having attracted the men, it becomes obvious that it is to the interest of the State to retain them, more especially when their profession is one requiring training and experience. The rates of pay offered to telegraphists are not generous, and are barely sufficient to get men of sufficient intelligence and ability to perform the work.

It can be shown that what may be called the subsistence level of a sufficiently intelligent telegraph clerk has been reached, as recent attempts to lower the scale of pay and requirements have signally failed. The 46th annual report of His Majesty's Civil Service Commissioners shows that the telegraph service is becoming unpopular, as there has been a marked dearth of candidates; this would have become still more marked had not the various schools in London for preparing candidates for Civil Service examinations advertised the salary of London operators as rising to £190 per annum, although to-day the Department state it is but £160.

Soon after the Fawcett revision, it was not uncommon for eight or nine candidates to present themselves for every vacancy for male telegraph learner. The consequence was that the State had a good choice of well-educated youths.

That the scales are not sufficient to secure contented service is shown by another class of facts. The cable companies attract a sufficiency of candidates for their own employ by offering better terms than the Post Office. The Eastern Co., for example, only find it necessary to offer a scale with £204 as a maximum to attract the best men from a State service. These two classes of facts show that the present scales are the lowest possible which will attract candidates and are not sufficient to retain the best men. It is often stated that Civil Servants do not resign, and that this fact shows absence of discontent. Telegraphists do, however, leave whenever opportunity exists. Since 1897 over 100 telegraphists resigned the Civil Service from the Central Office alone. Some went to South Africa, some to the cable companies, and in each case the Department would lose the services of men who had been trained and were competent operators. The scales as left by the Tweedmouth Committee are daily becoming less and less attractive, and less and less adequate. The demands of the service are becoming greater day by day, the cost of living is going up, and the scales are deteriorating in value. Again, two causes are operating to make the service harder. First, the development, speed, and complexity of working which compels increased individual output and its concomitant wear and tear. Secondly, the deterioration of duties.

If a comparison with outside workers is sought in regard to pay the conditions of work and the hours of duty must also be considered. A telegraphist has no regularity in his working hours or meal-times. His domestic arrangements and social enjoyments are liable to constant interruption. His ordinary duties vary day by day, week by week, and in, addition, he may be stopped on overtime without notice. Telegraphic work is subject to great fluctuations, and the hours of attendance are adjusted to meet in some degree the necessities of the business.

Side by side with increased demands, there has been a steadily

increasing expenditure in the necessaries of life, which has made the remuneration the men receive of less value to them. The cost of living has risen because, *inter alia*, there has been an increase in the cost of housing, rates and taxes, travelling and provisions.

The whole county of London is becoming overcrowded and untenable for men of the class of civil servants who are being pushed for house room into districts lying quite outside the metropolitan area. This outward movement increases the cost of travelling to and from the office and also the time occupied in actually performing the duty. Whereas 10 years ago the average cost annually of travelling did not exceed £4 to £5, it is an uncommon occurrence now to have to pay less than £6 to £7, and there are hundreds of telegraphists at the Central Telegraph Office paying £9 to £10 per year. The average time occupied in travelling at each end of the duty has also risen from about 40 minutes 10 years ago, to an hour or 70 minutes to-day.

The cost of housing has increased enormously. The rents of houses occupied by telegraphists in all districts show a rise in price, and even where cheaper travelling facilities have been introduced the rents have been raised to an extent far exceeding the economy effected in the daily journey.

Side by side with these increased demands upon the workers by the decreased value of their money owing to increased cost in necessaries, there has been an actual deterioration in the scales due to two main causes as compared with 10 years ago; promotion is less rapid, and progress to the maximum is cut off to the great majority. Owing to certain changes, the attainment of the maximum of £190 even has been cut off, and progress has been blocked at £160.

As long ago as 1890 it was possible for a man to reach £190 with about 21 to 22 years' service, but progress up the scale has gradually become more difficult, until to-day it is practically impossible for a man to pass the £160 point. In a cheaper economic period when Mr. Fawcett fixed £190 as a telegraph operator's maximum in London, he stated with regard thereto that "the rates of pay which I propose are not more than sufficient to afford just and reasonable remuneration to those on whose efficiency and contented service so much of the interests and convenience of the community depend."

A much larger question is that of pensions. There is no doubt that the prospect of a clerk who lives until the age of 60 years receiving a pension has a material effect in reducing the wages of the staff.

A London telegraphist to-day, since the reduction of his prospective salary, cannot get more than £160 per annum, and after 40 years' service his pension will be about £2 per week. A yearly contribution of £6 would give the same pension to an ordinary man at 65 years of age as a telegraphist gets after 40 years' service.

When pensions are taken into account for the purpose of reducing wages to the lowest possible point, it is only fair that the value of the superannuation laws to the State, as against the immediate interests of the workers, should be considered.

The demand formulated by the Association is as follows for London:—"That the remuneration of telegraph clerks in London shall be £50 per annum after 18 months' service and then rise by annual increments of £7 10s. to £140, after which the annual increments shall be £10 until £230 is attained."

LEGAL.

Knight *v.* The Isle of Wight Electric Light and Power Co.

(*Continued from page* 901.)

In the Chancery Division of the High Court of Justice on December 5th, Mr. Justice Joyce resumed the hearing of this action, which has already been referred to in our issues of November 27th and December 4th.

Mr. Waggett, following Mr. Younger, K.C., on behalf of the defendants, submitted that the Court would not interfere where the nuisance was connected in the construction of public works, and was of a temporary and occasional character only.

Mr. Justice Joyce: Do you consider your evidence has proved there must necessarily be a nuisance occasioned until the works had been in operation, say, for six months. Of course you cannot be justified in doing anything which is a nuisance, except it be necessary.

Mr. Waggett said the evidence showed that what had been done was incidental to construction, and the Act of 1882 gave the defendants an indemnity as to that. The evidence, said counsel, was very conflicting. What the plaintiff called a maddening noise, the witnesses for the defence described as the "hum of a bee in a bottle."

Mr. Justice Joyce: Are you entitled to disturb Miss Knight with the hum of the dynamo?

Mr. Waggett said his case was that the plaintiff did not hear the hum of the dynamo except by listening for it, and that the smells emitted from the works were of a very faint character, and had now been practically cured.

Mr. Justice Joyce said that the smells which had been cured might have been caused by the ignorance of the defendants, and that was their misfortune.

Mr. Waggett said they were unavoidable in connection with the starting of the works, and everything had been done by the defendants to diminish the smells as speedily as possible. The plaintiff must submit to the sound of lawful works being conducted in a proper way. She was not entitled to the quiet of a cloister. The engines of the defendants were not yet out of the hands of the makers, and whatever noise there was would be cured next week.

Mr. Justice Joyce: My present impression is that these works can be carried on without causing a nuisance, if you will only go to the expense. It must be taken there was annoyance at one time.

Mr. Waggett said it was impossible to set the works in order, except in the way that had been done.

Mr. Justice Joyce: Why could not the nuisance have been avoided in the way that has been done since?

Mr. Waggett said the engine was of a new type, and defects which could not have been foreseen made themselves known from time to time, and had to be cured by degrees. If during the construction of the works there was annoyance to the plaintiff, he submitted it was of such a character that the plaintiff had no legal relief.

Mr. Justice Joyce said, as the case was an important one, he would require to hear Mr. Hughes's reply on behalf of the plaintiff, and the case was accordingly adjourned for that purpose until Tuesday week.

Ferranti, Ltd.

In the Chancery Division on Saturday, Mr. Justice Joyce had before him the action of Poole *v.* Stirling and Ferranti, Ltd., which came on as a motion for judgment.

Mr. Vernon, for the plaintiff, said the action was brought by debenture stock holders to enforce their security. The defendants, Stirling and Jones, were the trustees for the stock-holders, and Parr's Bank were second encumbrancers, they holding a debenture for £30,000 ranking after the debenture stock. Stirling and Jones consented to judgment, and so did the bank, but the company had not put in a defence. The debenture stock, to the amount of £100,000, was issued in November, 1901. The security had not yet become enforceable, and no interest was in arrear, but the company was insolvent and unable to pay its debts.

His Lordship made a declaration that the trusts of the debenture stock deed should be carried into effect, and directed the usual accounts and inquiries to be taken.

National Telephone Co. *v.* Phelps.

In the Chancery Division of the High Court on Friday last the case of the National Telephone Co. *v.* Phelps was mentioned to Mr. Justice Farwell.

Mr. Upjohn, K.C., said an injunction was granted *ex parte*, to be continued till that day, and it was proposed that it should be continued till the trial. In this case Mr. Phelps claimed the right to disconnect the cable of the National Telephone Co. which served some 66 subscribers, so that if that were done considerable public inconvenience might arise.

Mr. Jenkins, K.C., said the point between his learned friend and him had been quite clearly defined, and he suggested that the case should be put in the witness list. The only issue was whether the plaintiffs were entitled to maintain a certain cable and any apparatus that might be connected therewith upon certain premises in Southampton Row.

The case was ordered to be set down in the witness list.

Hallet *v.* Galway Electric Co.

This was a claim for £500 for damages, also an injunction to suppress a nuisance alleged to be caused by the defendants through the working, day and night, of two vertical turbines for the generation of current. It was heard at Dublin before the Master of the Rolls. Plaintiffs had been compelled to abandon their house because of the nuisance. After the case had been proceeding for two days defendants agreed to the injunction, but a stay was put upon it until March 13th, to enable the defendants to abate the nuisance complained of.

A Westinghouse Rumour.—The *Financial Times* of December 4th published the following, on the authority of its Manchester Correspondent:—"There is some uneasiness amongst local investors in the British Westinghouse Electric and Manufacturing Co., Ltd., at the delay in issuing the report for the 12 months ended July 31st last, generally issued in November, and also at the non-declaration of the half-year's dividend to that date on the 6 per cent. preference shares. This dividend was paid last year on December 30th. Since the last annual report £1,000,000 of preference shares have been issued at a premium of 10s. per share, one-half on December 15th, 1902, and the balance on June 4th last, the latter ranking for dividend *pari passu* with the then existing preference. In consequence of the present delay there have been a number of unfavourable rumours on the market in Manchester, and the buying price has fallen about £1 within a month. The company has big important electrical contracts in hand, but has often to give long credits."

Incorporated Municipal Electrical Association.—The address of the secretary, Mr. C. McArthur Butler, has been changed to Staple Inn Buildings (South), Holborn, W.C.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING DEC. 9TH, 1902.		WEEK ENDING DEC. 8TH, 1903.	
Alexandria	Value £192	Adelaide	Value £16
Amsterdam	30	Alexandria	54
Auckland	10	Amsterdam	207
Beira. Teleg. mat.	249	Bombay. Teleg. mat.	125,360
Bombay	241	Brisbane	123
Brisbane	79	,, Teleph. mat.	650
Buenos Ayres	298	Buenos Ayres. Teleg. mat.	1,786
Calcutta	177	,, Teleph. mat.	250
Cape Town	171	Calcutta	583
Channel Islands	31	,, Teleg. mat.	660
Cologne	130	Cape Town	2,001
Colombo. Teleg. mat.	64	,, Teleg. mat.	20
Copenhagen	150	Colombo	24
Demerara	30	Copenhagen	104
Durban	1,216	Delagoa Bay. Teleg. mat.	1,008
,, Teleg. mat.	6,371	Durban	782
East London	42	,, Teleg. mat.	167
Fremantle	868	East London	1,047
Gibraltar	100	Fremantle	130
Hamburg. Teleg. mat.	500	Hong Kong	133
Hong Hong	27	,, Teleg. mat.	56
Kobe	210	Lisbon	25
Melbourne	672	,, Teleph. mat.	56
Nagasaki. Deep-sea cable	4,077	Melbourne. Elec. tramway mat.	1,812
,, Elec. motors	936	Montreal	16
New York	30	Odessa	241
Ostend	30	Para	17
Perth	50	,, Teleg. cable	5,303
Port Elizabeth	312	Perth	355
Port Louis	49	Port Elizabeth	132
Port Said	29	St. Petersburg. Teleg. wire	330
Rosario	78	Shanghai	95
St. Petersburg. Teleg. wire	38	Sydney	276
Shanghai	378	,, Teleg. mat.	202
Singapore	24	Vigo. Teleg. cable	30
Stockholm. Teleg. wire	185	Wellington	93
Sydney	105	Yokohama	105
,, Teleg. cable	192	,, Teleg. wire	508
Toronto	63	Zanzibar. Teleg. mat.	22
Valparaiso	70		
Wellington	138		
Yokohama	342		
Total	£18,484	Total	£144,724

Foreign Goods Transhipped.

Gothenburg. Elec. apprts. Value £15

Australian Patents.—Messrs. W. P. Thompson & Co. writes:—"It will be of interest to your readers to know that the Parliament of Federated Australia has passed a Patent Act to cover the six States forming the Commonwealth, namely, New South Wales, Victoria, Queensland, South Australia, West Australia, and Tasmania. New Zealand is excepted.

"The Bill, which was introduced into the Australian Senate and received its first reading on June 26th, has now been assented to, and the commencement is to be fixed hereafter by proclamation. The Act follows in general the British Act, but modifications are numerous and important.

"The principal provisions may be summed up as follows:—Patents to be granted for 14 years to cover the six States comprising the Commonwealth; examination as to novelty to be made to a limited extent; actual working of the invention within the Commonwealth is not necessary; compulsory licenses may be granted after two years to any person proving that the reasonable requirements of the public have not been satisfied; applications for patents may be filed by the inventor or his assignee, by the representative of a deceased inventor or assignee, or by a communicatee; additional patents are provided for at half fees; a patent is valid as to all good claims, notwithstanding that it may contain one or more invalid claims; power is given to apply the provisions of the International Convention, period of priority to be 12 months, to accord with the additional Act of Brussels. Existing State or Colonial patents may be converted into Commonwealth privileges for the unexpired period; but if the invention is not novel, has been published, or has been made the subject of a pending application in any State other than the State in which the existing patent was granted, then any such State may be excepted.

"It is rumoured that the new Act may take effect as early as next month, and if, therefore, holders of patents in one or more of the existing States or Colonies desire their patents extended so as to cover the remaining territory of the federation, it will be wise to take advantage of this provision at the earliest possible moment.

The cost of a patent under this new Act to cover the six States comprising the Commonwealth will be about one-sixth of the cost of taking out patents at the present time to cover the same area. There is, however, a fee of £5 payable before the actual issue of the patent, and a renewal fee of £5 before the expiration of the seventh year.

"The laws as to trademarks, designs and copyrights are in no wise altered, and it is still necessary, and will be for some time, to take independent steps in each State for their protection."

Arc Lighting at Batley.—We learn that the Gilbert Arc Lamp Co., Ltd., have, as sub-contractors to Messrs. Callender's Cable and Construction Co., Ltd., designed and supplied the arc lighting equipment for Batley, Yorks. An interesting feature is the use of the Gilbert Co.'s raising and lowering gear on the tramway poles, for which special boxes and winches had to be designed. The steel cord is carried up the outside of the post in 3/8 pipe from the combined winch and gear-box which allows for the necessary lateral motion of the cord, and the whole has been so contrived that it is quite neat and unobtrusive. Messrs. Lacey & Sillar are the consulting engineers.

Trade Announcements.—An agreement has been made between Messrs. Brown, Boveri & Co., of Baden, and the Societa Anonima Tecnomasio Italiano Cabella, and the latter has now assumed the title of "Tecnomasio Italiano Brown-Boveri." The company will construct dynamo-electric machines and accessories under the Brown-Boveri systems, whose technical men will personally direct and supervise things. The Italian firm of Brown, Boveri & Co. ceases to exist, and the Tecnomasio Co. becomes the general agent for the Swiss firm in Italy, the Levant, &c., its chief address being *vid* Principe Umberto, 27, Milan.

Owing to increased business Mr. Douglas Wells, M.I.E.E., has removed to No. 10, Rue de la Pépinière (Brussels), where he will keep a stock of electrical stores for immediate delivery.

Mr. James Melling, of Dashwood House, New Broad Street, E.C., has been appointed the sole representative of Messrs. Mitchell and Sons, Ltd., of Bolton, who possess very large stocks of second-hand machinery and plant.

Messrs. Plutte, Scheele & Co., of 18 and 19, Queenhithe, E.C., have been appointed agents for the United Kingdom for the firm of Messrs. Schmahl & Schulz, of Barmen, manufacturers of electric light accessories. They will send catalogues on application.

The address of the British Electric Calibrated Fuses, Ltd., has been altered from 118, Queen Victoria Street, E.C., to 137, Fenchurch Street, E.C.

The telephone number of the Hart Accumulator Co., of Stratford, will next Monday be altered to No. 823 East.

Books Received.—"Fowler's Electrical Engineers Year Book and Directory of Light, Power and Traction Stations, 1904." Manchester: The Scientific Publishing Co. 1s. 6d. net.

"Australian Commonwealth Patents Act, 1903." Adelaide: F. H. Snow.

"Transactions of the American Electro-Chemical Society," Vol. IV. Philadelphia: The Society. 1903.

"Electric Traction," by J. H. Rider. London: Whittaker & Co. 10s. 6d. net.

"Modern Electric Practice." Vol. I. Edited by Magnus MacLean. Complete in 6 vols. London: The Gresham Publishing Co. 9s. net.

Electric Time Stamp.—An ingenious improvement in chronometric time stamps has just been patented by Mr. Egon Burda, of 92, Elgin Crescent, London, W. By means of this instrument, the time of day, correct to one minute, the day of the month, the year, and whatever other data it is desired to record, are automatically registered and impressed on letters and other documents. The device consists of a box or case containing the mechanism which changes the relative positions of the type-wheels, together with an electro-magnet which provides the necessary motive power to actuate the mechanism. A controlling watch is mounted in a knob above the case, and is automatically wound up once every minute; a dial at the side shows the day of the month, the hour and minute for which the stamp is set at any moment. The type-wheels which indicate the month and year are set by hand, as these only occasionally require alteration. A self-acting inking roller and pad are provided. On depressing a plunger by means of the knob aforesaid, the type-wheels are inked and the type impressed upon the paper to be stamped.

In a modification of the apparatus, a tape or ribbon is automatically fed through it, and the time stamp is impressed thereon by closing the electrical circuit from a distance, as, for example, when a night watchman is making his rounds.

The device is worked out in detail with great ingenuity; provision is made for setting and adjusting the wheels for ensuring their alignment, &c., and a very small battery or other source of electrical energy suffices to energise the mechanism. The dial serves as both clock and calendar. Where several such apparatus are in use, they may all be controlled from a central standard clock, as in post offices, banks and similar business houses, for which they are particularly suitable.

German Electrical Machinery Trade.—The German Customs returns for the nine months ending with September last show that during that period the imports of electrical machinery into the country only amounted to 662 tons, as compared with 1,092 tons in the corresponding nine months of 1902. On the other hand, the exports of electrical machinery from Germany during the first nine months of the year reached a total of 9,695 tons, which contrasts with 9,656 tons in the corresponding period of last year.

American Electrical Exports.—So far this year there has been an increase in the exports of electrical fittings and accessories from the United States, the returns for the nine months ending with September last showing a total of £714,208, as contrasted with only £614,820 in the corresponding period of last year. On the other hand, there has been a decrease in the exports of electrical machinery from the United States from £879,830 in the first nine months of 1902 to £775,018 in the nine months ending with September last.

Workers' Safety.—Mr. Heathman, of Parson's Green, London, S.W., the well-known ladder maker, has produced a safety waist-belt for the ladder man. It is fitted with a large snap hook to go over the rung of any ladder, and is adjustable to enable a man to have great freedom of movement in all directions as well as to turn right round if he is upon a platform and wishes to put his back towards the ladder.

A Johannesburg Contract.—Messrs. A. W. Penrose and Co., of 109, Farringdon Road, E.C., have secured the entire order for generating plant, including engine, dynamos, &c., and also for two passenger and one goods lift, for the new buildings of Messrs. Harvey, Greenacre & Co., of Johannesburg.

Bankruptcy Proceedings.—The creditors of George Neale, electrician, 2, Fulham Palace Road, S.W., lately trading with John Carnaby as the South-Western Electrical Contracting and Maintenance Co., met last week at the London Bankruptcy Court before Mr. G. W. Chapman, Official Receiver. The debtor states that he commenced business at Wimbledon in March, 1900, and traded as Neale & Croft until August, 1900. He had no partner, but Mr. Croft assisted him financially. After closing that business, he entered into partnership with Mr. S. R. Gardner, and they traded at 802, Fulham Road as Ryland & Neale, Mr. Gardner providing the necessary capital from time to time. That partnership lasted until January 11th, 1902, when they quarrelled, and parted on terms by which he (debtor) had to pay Mr. Gardner £300. Upon looking into the matter further, he disagreed with the figures, and on that ground he had paid no part of the £300. He subsequently continued the business alone under the style of the South-Western Electrical Contracting Co., until September, 1902, when he was joined by Mr. Carnaby, who brought in £500. They traded at 2, Palace Terrace, Fulham, until August 1st last, when the business was assigned to a company, which was formed to take it over. He (debtor) received £50 cash, £350 preference and £500 ordinary shares, and was retained to manage the company at a salary of £200 a year. In January, 1903, before the company was started, he and Mr. Carnaby entered into an arrangement to open a new business as dealers in motor-cars and accessories. They purchased a Panhard and three motor-wagonettes with a view to getting them licensed as public conveyances. That business was not assigned to the company, but was to be carried on as the South-Western Motor Co. He attributes his failure to Mr. Carnaby's refusal to carry out his promise to meet the bills given for the motor-wagonettes, and to share the expense of putting the same on the road. No accounts had been filed by the debtor, who estimated his liabilities at £500 undisputed, and £500 for disputed claims. The assets consist of a book debt for £159, regarded as of doubtful value, and 10 shares in the South-Western Electrical Co. In the absence of any offer the case was left in the hands of the Official Receiver to be wound up in bankruptcy, the debtor's public examination being fixed for January 15th next.

Dissolutions and Liquidations.—The British Fuel Economiser and Smoke Preventer, Ltd., is winding-up voluntarily, with Mr. R. G. Orr, 12, Great Dover Street, S.E., as liquidator.

The Electrophone, Ltd., is winding-up voluntarily. Messrs. A. Anns, Telephone House, Victoria Embankment, E.C., and H. S. J. Booth, 36, Gerrard Street, W., are liquidators.

Messrs. C. D. Falcke and P. West (Birmingham Electrical Fittings Co., 113, Coleshill Street, Birmingham) have dissolved partnership.

Notice is given of release of liquidator in *re* Beaman & Deas, Ltd.

A meeting of the Standard Electro-Galvanising Co., Ltd., will be held at Birmingham on January 11th, to hear an account of the winding-up from Mr. C. E. Field, the liquidator.

Messrs. S. Appleyard and T. Stather (Appleyard & Stather, electrical engineers, Hull) have dissolved partnership. Mr. Stather will attend to debts.

Fire.—The telephone works of the British L. M. Ericsson Manufacturing Co., at Beeston, Nottingham, were partly destroyed by fire on the 3rd inst. We understand that though considerable damage was done, work will be resumed in a short time. In the interval the company are in the fortunate position of holding sufficient stock to enable them to continue deliveries as usual.

Boston.—We understand that new works for the manufacture of induction coils for ignition purposes in connection with motor-cars are about to be established at Boston (Lincs.)

Catalogues and Lists.—Messrs. Mather & Platt, Ltd., have sent us a copy of the third edition of their two-cycle gas engine catalogue. Photographic views are given of their 500-B.H.P. and 700-B.H.P. single-cylinder Körting engines, the 700 H.P. size having been at work successfully for some time with producer gas at a large chemical works, and it is stated that engines are in course of construction developing up to 2,000 B.H.P. Another catalogue received from the same firm, is the second edition of its list of D-type dynamos; it includes particulars of a range of 12 machines for smaller outputs than those listed in the firm's multipolar dynamo catalogue. The three smallest sizes are of the two-pole type, the others being four polars, the KW. capacity ranging from 1 to 2 up to 63 KW. for 110 volts, and up to 84 KW. for 220 volts; the 440-volt machines are from 11 to 84 KW., and the 550-volt from 12½ to 75 KW. Dimension drawings and tabulated weights and dimensions are included.

Messrs. Estler Bros., of Laurence Pountney Lane, E.C., have issued two new pamphlets. One gives a description of Harvey's patent automatic electric tramway signal. The other details, with illustrations, the Imperial rail joint (Scheing & Hoffmann's patent).

The Hyatt Roller Bearing Co., of Harrison, N.J., have sent us a copy of their bulletin No. 20, showing a number of applications which have been commercially made of the Hyatt roller bearings for conditions involving heavy duty at slow speed. Many excellent illustrations are given showing these various adaptations.

Messrs. E. F. Moy, Ltd., of Camden Town, N.W., have brought out a list of their type No. 76 supply companies' fuses, for pressures up to 250 volts.

Catalogue "P.C.," issued by Messrs. Johnson & Phillips, of Old Charlton, gives prices and details of low-tension "Manilla" paper-insulated, lead-covered and armoured cables and twin house-wiring cables.

Messrs. Hans Renold, Ltd., of Progress Works, Manchester have sent us a copy of their new general catalogue No. 100. It deals with the four principal types of driving chains manufactured by the firm, and gives various illustrations of typical transmissions.

The Edison & Swan United Electric Light Co., Ltd., have issued four November leaflets. No. I 2,018 comprises a new line of small portable ammeters and voltmeters for stationary and portable accumulators, which are also specially suitable for motor-car batteries. The larger ones are made in round and square cases, the former being of polished brass, the latter of cast aluminium. The terminals have a special device, which makes it impossible for the milled nuts to come off. A watch type of voltmeter, with flexible cord and two contacts is also listed; this is also suitable for ignition cells, &c. It is put up in a gun-metal case, with silvered dial. All these instruments are made at the company's works at Ponder's End. No. H 2,019 describes the "Liliput" arc lamp, with accessories. It has been a frequent complaint of users of electric glow radiators that they could not obtain spare lamps. The "Ediswan" Co., in No. L 2,021, illustrate the new and improved "Royal Ediswan" radiator lamp. An oval window has been introduced into the obscured glass through which the filaments can be inspected. In addition, an improved and ventilated flanged cap is provided and secured by extra hard cement; this ensures better fixing of the cap. The filaments are prepared by a special process, giving increased strength. In order to avoid the necessity of having so many "points" in such places as offices, factories, &c., where appearance is not a *sine quâ non*, the "Ediswan" Co. introduced their three-plate pattern H.V. ceiling rose, by means of which two or more flexible pendants may be controlled by more than one switch. The special porcelain bridge separates the terminals from each other, and secures immunity from short-circuit, whilst relieving the terminals from all strain. This device is detailed in their list No. A 2,022.

Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, have issued a revised catalogue of their Lundell and Castle electric motors. Many first-class pictures show some of the applications of the motors for driving different classes of machinery. Among the other illustrations is a sectional view showing very clearly the construction of the two-pole motor. A number of efficiency curves are given, also directions for the motor attendant, and for operating motor-starting switch with the automatic release. The Holmes-Clatworthy system for driving printing machines is explained, and a list of newspaper offices using this class of equipment given. We understand that a new feature of the Lundell two-pole single field-coil type of motor is the extension upwards of the commutator and casing to form a protection to the terminal blocks, which are thus completely enclosed. The multipolar Castle machines, which are particularised in the catalogue, are a new series of motors which Messrs. Holmes have just put on the market.

Messrs. Falk, Stadelmann & Co., have issued their 1904 catalogue of telephones and telephone parts and accessories. It contains woodcuts and prices of a variety of receivers, transmitters, hand-combination micro-telephones, battery ringing stations, magneto ditto, magneto-generators for testing, central stations for reply and call, intercommunication sets for battery or magneto, switchboards for exchange use, the "Logophone" domestic instrument, and many bells, batteries and sundries for telephone service. The last 10 pages of the catalogue are devoted to diagrams of connections.

Cricket Club Dinner. — The annual dinner of the Drake & Gorham, Ltd., Cricket Club, was held at the Falstaff Restaurant, on the 2nd inst., nearly 100 being present. The chair was taken by Mr. Bernard Drake, Mr. Gorham and Mr. M. G. Drake also being present. The hon. secretary and treasurer, Mr. H. Beenham, reported that 22 matches had been played, of which 8 had been won, 2 drawn, 5 lost, and 7 abandoned owing to the wet season; also that the club was in a satisfactory financial position with a considerable carry forward to next year. The secretary of the company, in proposing the toast of "Success to Drake & Gorham, Ltd.," said it should be a matter for gratification to all concerned that, in spite of the general depression, last year's turnover was in excess of that of any previous year in their record. The chairman, in reply, stated that although the managing directors organised to the best of their ability, the final result must rest with the men themselves. Mr. Hamilton, the manager of the Manchester office, in proposing a vote of thanks to the chairman, said that it was his main object to further friendly relations between the head office and the branches. A number of songs and recitations were well received, and a most enjoyable evening was spent.

For Sale.—Certain gas engines and electrical plant at the premises of the Don Clothing Co., in Holborn Viaduct, are to be offered for sale by auction on December 17th by Messrs. Tomlin and Co.

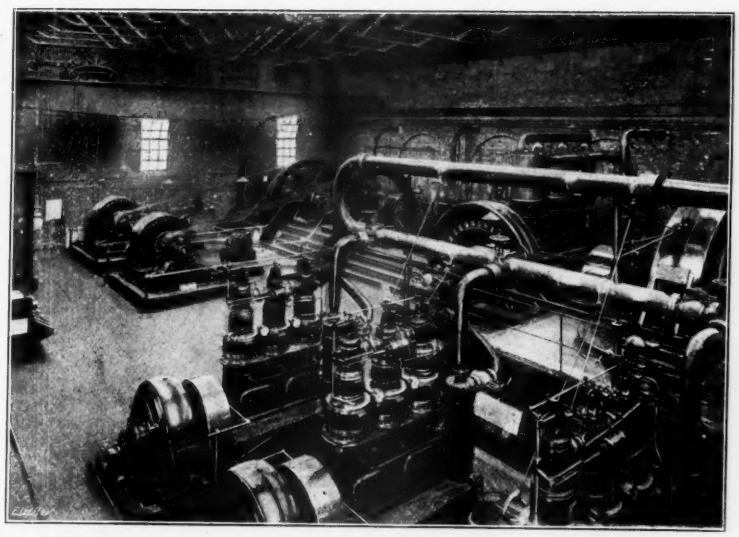
Eastbourne.—A five days' electrical exhibition was held last week by the T.C. at the Town Hall. Local firms were responsible for a number of the stalls. The Finsen light cure was exhibited. The Electricity Department displayed motors, &c., and incandescent lamp manufacturing was carried on by the Robertson Lamp Works. The exhibition was opened by the Mayor.

The E.L. Committee of the Corporation is now considering the advisability of extending the mains to the village of Willingdon, outside the borough. If this extension is decided upon, the price of energy will be reduced from 6½d. to 5½d. per unit.

A L.G.B. inquiry was recently held into an application by the T.C. to borrow £10,000 for electric lighting extensions. There was no opposition.

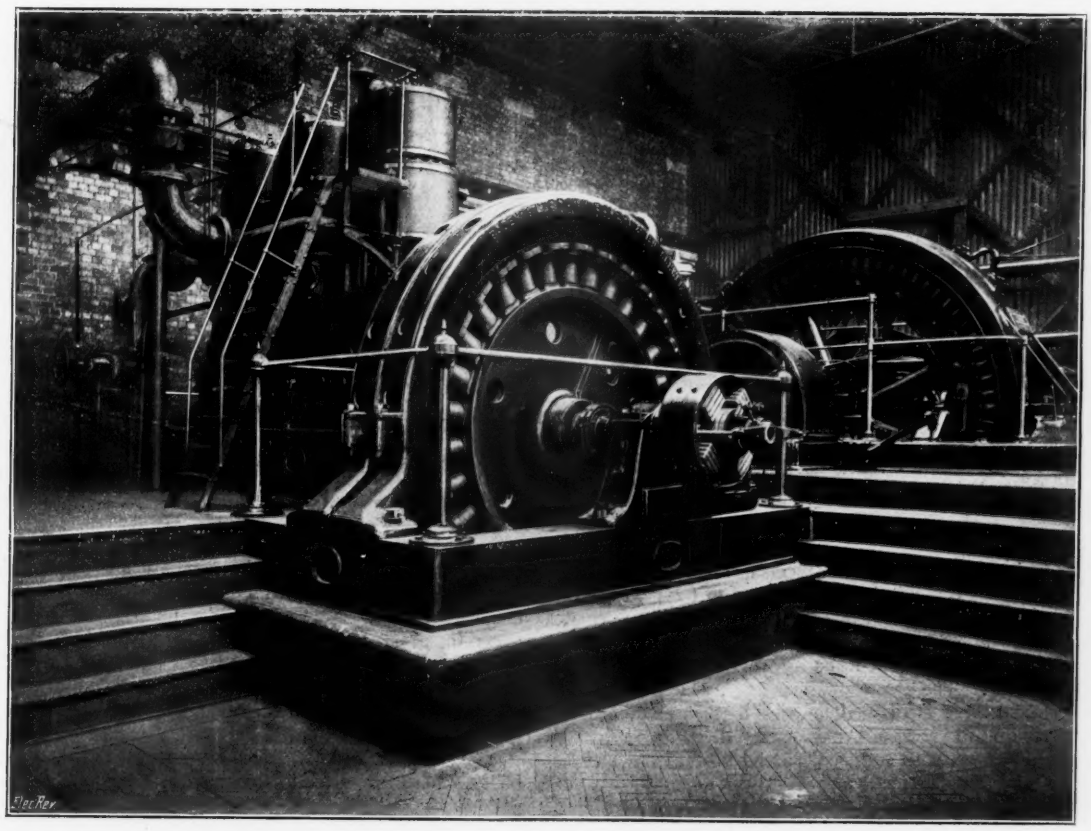
BURTON ELECTRIC LIGHTING AND TRAMWAYS.

Whatever may be the state of trade in other towns, there can be no doubt that Burton—"where the beer comes from"—has no complaint to make. The town is a hive of industry, unique in respect of the suitability for brewing ale of the water pumped up from deep wells in various parts of the district; it is also remarkable for the extraordinary number of level crossings which are met with in all quarters of the town, leading to the respective breweries. The population numbers 52,000.



General View of Engine Room.

The municipality has possessed an electric lighting installation since 1894; this was laid down by Mr. F. L. Ramsden, the manager of the gasworks, and until recently the undertaking remained under the control of the Gas Committee. The engine room is of plain but substantial design, with brick walls and a lantern roof; it is lighted both from the side and by sky-lights. The original installation consisted of three 75-kw. Fowler alternators, rope-driven by horizontal compound engines, also of Messrs. J. Fowler and Co.'s make, and generating single-phase current at 2,000 volts, 75 cycles per second. These were very good machines, easily capable of standing 50 per cent. overload and even dead short-circuits; they were of the revolving field type, with 20 poles, and ran at 450 revolutions per minute. The exciters were driven by ropes from the alternator shafts. The engines ran at 93 revolutions per minute,



Large Single-phase Generating Sets.

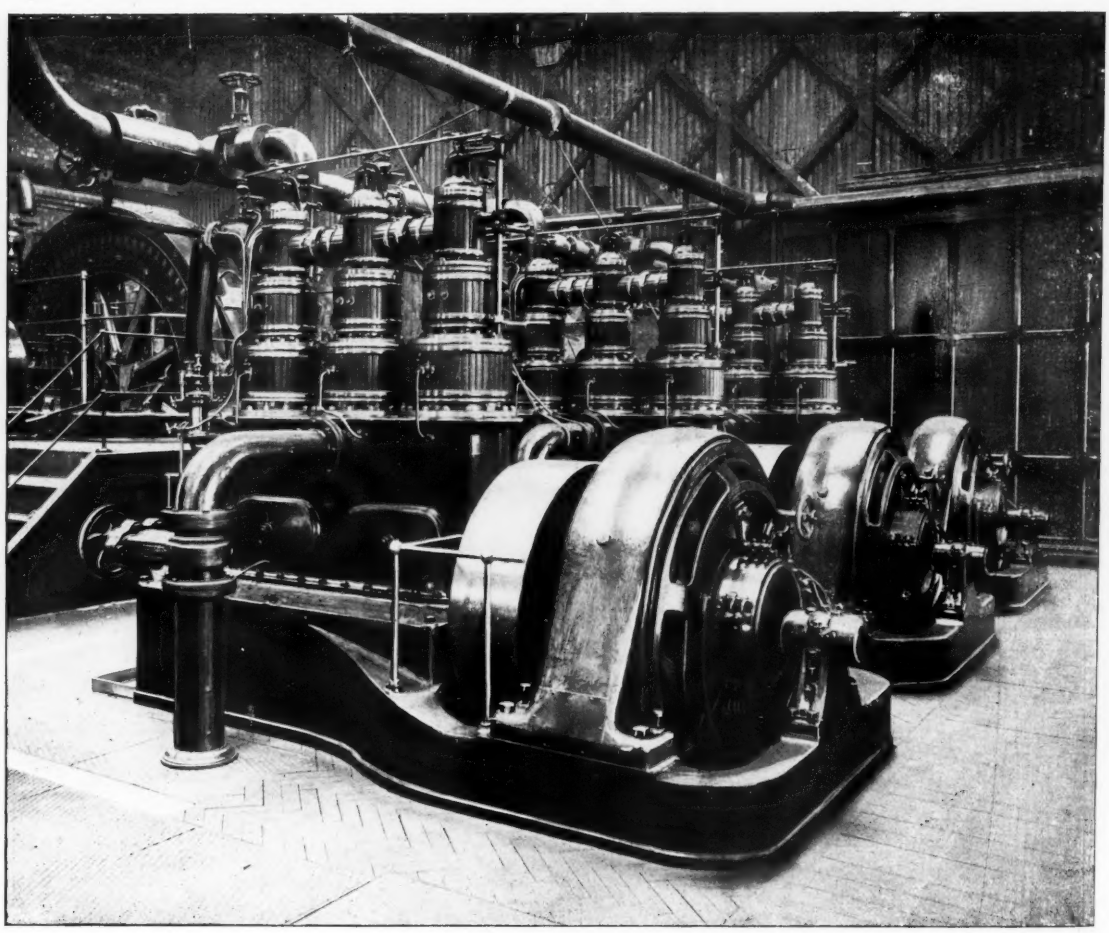
and were provided with automatic expansion valve-gear on both cylinders. Two of the sets are still in daily use, the third having been removed to make room for a larger set. Before this took place, a 240-KW. alternator of the same make was installed in 1899, direct-coupled to a Fowler horizontal compound engine, running at 125 revolutions per minute. This engine is equipped with piston valves and with automatic expansion valve-gear on both cylinders, consisting of a piston valve sliding inside the main valve. The governor is of the Marshall type, driven by a Renolds chain. The alternator is similar to the smaller ones, the fly-wheel magnet carrying 72 poles. The exciter is driven by ropes from the main shaft.

Further extensions soon became necessary, and in 1901 one of the small sets was removed to make room for a 400-KW. direct-coupled set. This is shown in one of our views, and consists of a Brown-Boveri alternator driven by an Alley & MacLellan vertical three-crank tandem compound engine at 300 revolutions per minute. The alternator is, like the rest, of the fly-wheel magnet type, the fly-wheel web consisting of a disc, cast in one piece with a ring, to which 30 magnet poles are bolted. The exciter is a four-pole dynamo, with its armature carried on the end of the main shaft. The stationary armature, which is of the usual slotted type, is divided on the horizontal diameter. The engine is of Messrs. Alley & MacLellan's standard single-acting type, with cylinders 15 and 25 in. in diameter, 12 in. stroke. This set was supplied by Messrs. Geipel and Lange, of Westminster. The two large sets are provided with jet condensers, each driving its own air pumps; in the case of the Fowler engine, this is effected by a tail rod, while the Alley & MacLellan engine drives an Edwards pump by gearing from the crankshaft.

The A.C. switchgear is of the Fowler plug pattern, and consists of four generator panels, two feeder panels, and a voltmeter and synchronising panel. By the side of it a five-panel switchboard for the exciters is fixed, and in front of the main board is a bank of rheostats for regulating the excitation of the alternators. The A.C. board is provided with two sets of bus-bars, and any feeder or generator can be plugged on either of these.

The newest plant is that which has been installed for working the tramways, and consists of three British Thomson-Houston dynamos of 100 KW. each, driven by Willans engines. The generators are of the six-pole type, compound wound for 500—550 volts, and run at 450 revolutions per minute. The engines are three-crank compound, with automatic expansion gear. Steam is supplied to them by a separate ring main direct from the boiler house, and a central jet condensing plant is provided for all three, consisting of a three-throw Edwards air pump, made by Messrs. Yates & Thom, geared to a 22-H.P. Johnson-Lundell motor.

The main switchboard belonging to these sets, supplied by the British Thomson-Houston Co., Ltd., who were contractors for the whole of the traction generating plant, stands in front of them, and consists of 10 panels of black enamelled slate. These provide for six feeders, three generators, and the Board of Trade instruments; they are equipped with automatic circuit-breakers, ammeters, and the necessary switches. Two bracket voltmeters are fixed at the end of the board, and three main watt-hour meters are provided.



View of Traction Generators.

The engine room is traversed by a 10-ton crane. One end of the room is closed with corrugated iron, to facilitate future extensions. Water for feed and condensing is derived from the River Trent, which is close at hand, by means of two pipes 9 in. and 24 in. in diameter, leading to a sump close by the buildings; it is of a very hard character, and though softened by soda-ash, causes large deposits to accumulate in the boilers.

The boiler house contains six Lancashire boilers, working at a pressure of 165 lbs. per sq. in.; three of these were

made by Messrs. Yates & Thom, measuring 26 ft. × 8 ft. diameter, while the other three, by Messrs. Tinkers, measure 26 ft. × 8 ft. 6 in. Hopkinson fittings are used throughout. All the boilers are fitted with Perrott patent water-jacketed furnaces, and a system of forced draught, installed by Messrs. Bryan Donkin & Co., the draught being produced by a Sirocco fan on top of the boilers, driven by one or other of two small steam engines. The two chimney shafts are consequently comparatively short, one being 90 ft. high and 5 ft. 6 in. in diameter inside, while the other is 75 ft. high.

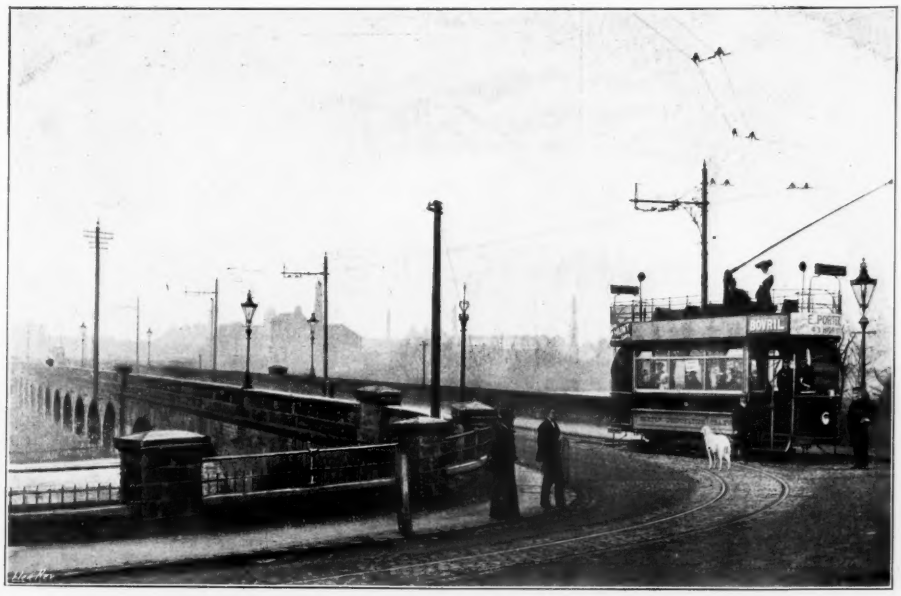
Two Green economisers are provided, of 156 and 192 tubes, with scrapers driven respectively by a steam engine and a B.T.H. motor. There are two Pearn and two Bailey duplex feed pumps, and three Berryman feed-water heaters which receive the exhaust steam from the small sets. For boiler feeding, water is pumped up into a tank over the boiler house, 16 ft. × 11 ft. × 4 ft. 6 in. deep.

Fuel costs ought to be very low at Burton; during light loads, by the aid of the forced draught, the refuse from the adjoining gas works is burnt, and as this has no market value, it costs nothing. It is mixed with 25 or 30 per cent. of slack, costing 5s. 9d. per ton.

The distribution of current for lighting is carried out with concentric lead-covered cables supplied by the British Insulated & Helsby Cables Co., Ltd., with the outer earthed; some of this is laid on the solid system, the rest being drawn into iron pipes and Albion earthenware conduits. The pressure is reduced to 100 volts by transformers in tanks under the street; some house transformers are used, where low-pressure distributors have not been laid. In the out-lying districts the supply is at 200 volts. The first mains laid were single, rubber-insulated, in iron pipes; these have given some trouble, and are being gradually replaced. In new work the transformers are to be installed in kiosks above the ground level.

Traction Switchboard.

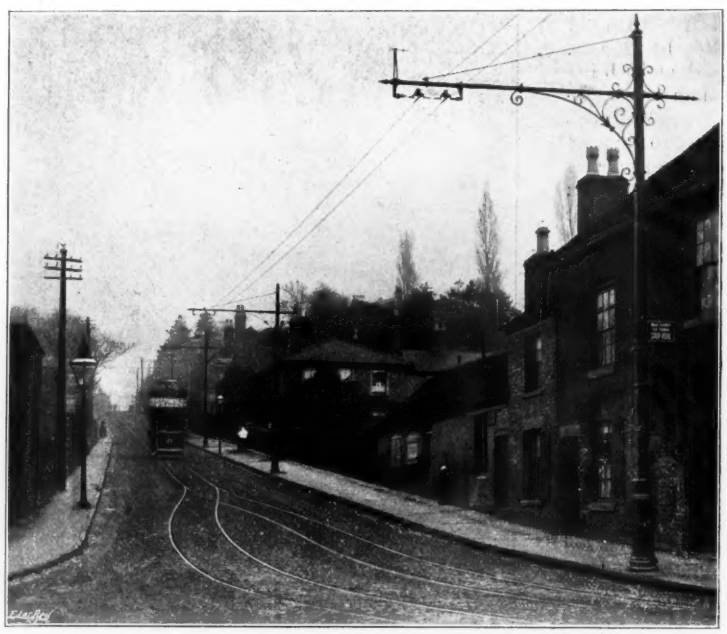
The number of consumers is now over 300, with the equivalent of about 24,000 8-c.p. lamps connected, showing an increase in 12 months of 25 per cent. Not much has been done with motors in the past, but this is rapidly changing; motors of 60 h.p. are now connected, and inquiries representing over 100 h.p. are in hand, with good prospects of adoption. Nearly all the single-phase motors used are of the Langdon-Davies make. The brewers are naturally good customers for lighting, and it is hoped that power will soon be supplied to them also. There is no street lighting, but experiments are in progress with a view to inducing the authorities to have arc lamps suspended for the tramway standards, some of which have been provided with wide bases to hold the switch gear. The charges are, for lighting, 6d. and 3d., on the maximum demand system, and for power, 3d. and 1d., or a sliding scale from 2d. to 1¼d., depending on the consumption. The total



Trent Bridge, Showing Tramway Construction (and Telegraph Poles).

lighting capacity of the works is 790 KW., and the maximum load last year was 318 KW.

The tramway scheme was taken in hand in 1900, when Mr. J. E. Waller, of Messrs. Kincaid, Waller, Manville and Dawson was appointed consulting engineer. The late Alderman Lowe, chairman of the Tramways Committee, put forth great efforts in promoting the scheme, and has a worthy and energetic successor in Mr. Councillor J. S. Rowland. Councillor T. E. Lowe is vice-chairman of the Tramways Committee and chairman of the Lighting Committee, of which Councillor C. A. Tresise is vice-chairman. The adoption of the tramway scheme led to the separation of the electricity and gas undertakings, and to the appointment of Mr. P. J. Pringle, M.I.E.E., as borough electrical engineer and tramways manager, with Mr. G. F. L. Alexander as chief assistant.



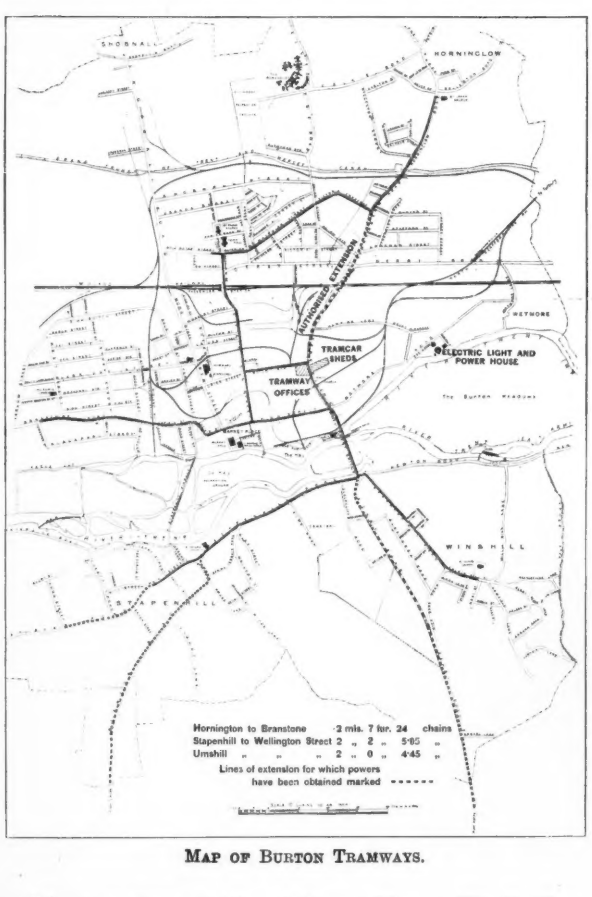
CAR ON BEARWOOD HILL.

Other members of the staff are Messrs. W. E. Few, T. Hall, and S. Mellor.

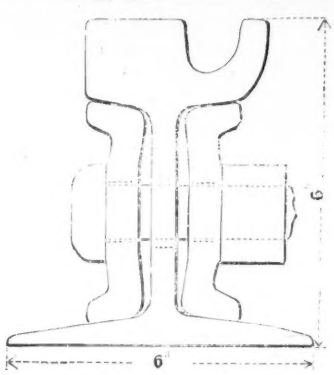
The tramway system is shown on the map annexed, comprising a total route mileage of 5¾ miles, and of single track 8½ miles; the powers obtained include the construction of 20 miles of single track, the whole being estimated to cost £80,000.

The system was opened on the August Bank Holiday, by the Mayor of Burton, and immediately became popular, the average number of passengers carried weekly during the first three months' working being nearly 90,000. The receipts per car-mile have averaged 11·9d., and the receipts per passenger 1·11d. The question of Sunday running was hotly contested, and a plebiscite was taken, which resulted in a victory of 3½ to 1 in favour. The three routes have a through fare of 2d., with overlapping 1d. fares, but from 5.30 to 8 a.m., and 5 to 6.30 p.m., the fare for any distance is 1d.

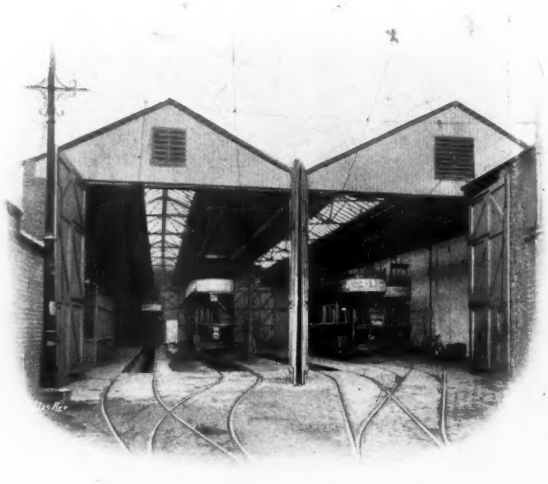
The track was laid by Mr. Finnegan, of Northampton, with 90-lb. rails, to 3 ft. 6 in. gauge; double track was used where possible, and in many cases the streets were widened to facilitate this; elsewhere single track was used, with turnouts. The line over the Trent Bridge, of which we give an


SHOBNALL
HORNINGLOW
EXTENDED EXTENSION
TRAMCAR SHEDS
TRAMWAY OFFICES
ELECTRIC LIGHT AND POWER HOUSE
WINSHILL
Hornington to Branstone 2 mls. 7 fur. 24 chains
Stapenhill to Wellington Street 2 „ 2 „ 5·65 „
Umshill „ „ „ 2 „ 0 „ 4·45 „
Lines of extension for which powers have been obtained marked

MAP OF BURTON TRAMWAYS.



SECTION OF RAIL AND JOINT.



CAR DEPÔT.

illustration, is single, but is laid on one side of the road, so that when the bridge is widened in the near future, it will only be necessary to lay a second track, and the existing side poles will become centre poles.

The feeder cables, together with the extension lighting mains, were laid by the British Insulated and Helsby Cables Co., Ltd., as well as the above-ground switch pillars. The overhead work was done by Messrs. R. W. Blackwell & Co., mainly with side poles and brackets, but also with span wires and rosettes, &c.

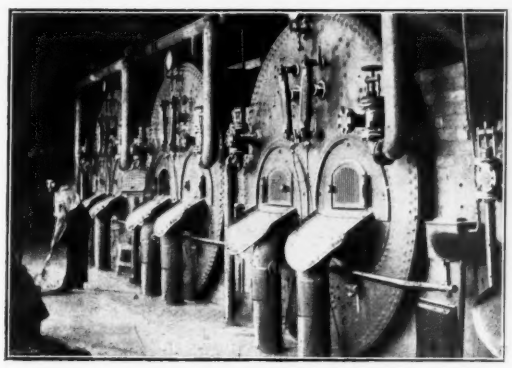
There are 20 cars, all of which were supplied and equipped by Messrs. Dick, Kerr & Co., Ltd. These are of the double-deck type, capable of seating 43 passengers, and are provided with swivelling trolleys. Each car is driven by two motors of 25 H.P. each. The steepest grade—about 1 in 12—occurs on Bearwood Hill Road, of which we give a view; five cars which run on this route are specially equipped with slipper brakes, and negotiate the hill in either direction with ease.

The energy consumed by the tramways is expected to amount to half a million units per annum, and already the output for this purpose has had the effect of reducing the works costs to a marked extent, the output in October, 1902, being 15,064 units, and in the same month this year 73,793 units.

An important scheme which has received Parliamentary sanction is concerned with the construction of a light railway through the coal mining and pottery districts of Gresley, Swadlincote, Woodville, Moira and Newhall, which possess a total population of nearly 50,000. The line will connect with the tramways of Burton, which is the nearest large town, and mutual running powers will be exercised; the combination will add largely to the traffic, as well as to the prestige of Burton. The light railway is being promoted by the Midland Railway Co., and is a noteworthy instance of enterprise on the part of that company.

We should add that the construction of the tramways has been carried out under the joint supervision of Mr. J. E. Waller and Mr. G. T. Lynam, the borough surveyor of Burton. An attempt was made by local influence to secure the adoption of a surface contact system; but the engineer naturally objected to this, and happily the proposal was frustrated.

In conclusion, we wish to express our obligation to Mr. P. J. Pringle for facilities to obtain photographs and particulars of the installation, and to Mr. G. F. L. Alexander, his chief assistant, for his unremitting courtesy and invaluable assistance in the preparation of this article.



Boilers Fitted with Forced Draught Furnaces.

Level Crossing in High Street.

UNDERGROUND CABLES IN SOUTH AFRICA.

From a Special Contributor at Johannesburg.

The great progress which has taken place in electrical work in South Africa since the end of the War can hardly be estimated. It would have been still more marked, especially in the Witwatersrand district, had it been possible for all the mines to resume work, and for the various new companies to start operations.

One noticeable advance in this district advocated by the consulting engineers to the Johannesburg municipality, Messrs. Mordey & Dawbarn, was the decision to lay the cables for the new power plant, both high and low pressure, underground, and to substitute a similar system for the original overhead mains.

In a few years' time Johannesburg will be able to boast of many miles of cable thus laid, instead of the present unsightly overhead ones; in fact, a beginning has been made, and already there are nearly 15 miles laid. These are situated in Parktown, the pretty and aristocratic suburb, about a mile to the north of Johannesburg.

In 1896 the Braamfontein Co. erected a small lighting station in the N.E. corner of Parktown, which now supplies nearly 50 consumers, but building has gone on apace, and the available power was quite inadequate, notwithstanding the addition of a set of accumulators.

Parktown having lately been included in the Johannesburg municipal area, the Town Council decided to buy up the plant of the Braamfontein Co. and supply current themselves, but their own central station was already taxed to its utmost capacity, so it was decided to erect a small temporary plant in Parktown itself, just large enough to supply all that area for a space of two or three years, until Messrs. Mordey & Dawbarn have carried out the new scheme for the Council, who will then be in a position to supply from their new central station in town. This new scheme (as readers of the Electrical Review are already fully aware, by reason of the detailed account of the Johannesburg scheme, which appeared in these columns on February 20th, 1903), includes traction, lighting and power supply.

It being decided to lay all the cables underground, tenders were invited, and the Telegraph Manufacturing Co. (Colonial) Ltd., representing the British Insulated and Helsby Cables, Ltd., secured the contract.

The cables were ordered on April 3rd last, and 12 weeks later, the first drum of cable arrived in Parktown from Prescot; and exactly 14 weeks from the day the order was given the first length of cable was laid—a splendid performance against time.

Meanwhile trenching had been started, and offered in

many places very rocky difficulties, and gelatine had to be used to blast the rock out, to obtain a sufficiently deep trench.

The temporary power house is a pumping station in the

Fig 1.—View of Johannesburg Power House. Fig. 2.—Arrival of First Drum. Fig. 3.—A Push all together

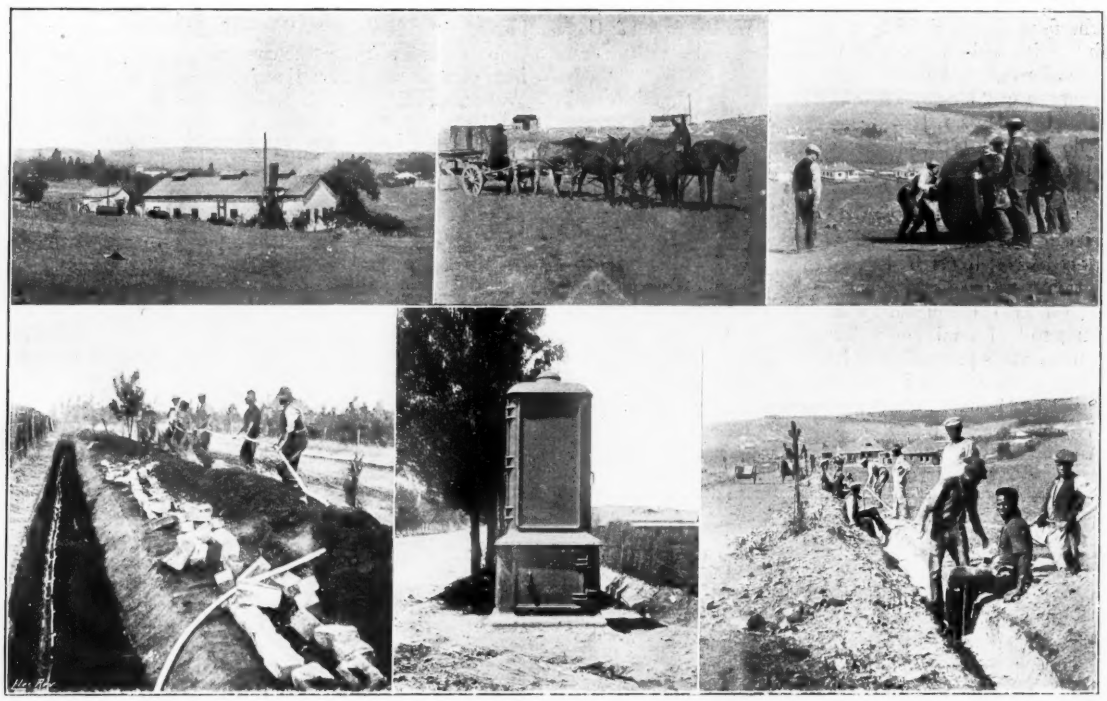


Fig. 4.—Laying H.T. Cables. Fig. 5.—Transformer Kiosk. Fig. 6.—A Bit of Blasting Work.

S.W. corner of Parktown, where a 250-H.P. Babcock and Wilcox boiler has been erected, and a 125-KW. two-phase 50-period alternator coupled to a Parsons turbine is in course of erection, together with switchboard and all accessories. The generating voltage is to be 3,000. Messrs. Reunert and Lenz have this part of the contract.

The H.T. cables are ·06 concentric paper-insulation and lead-covered, laid on the solid system in earthenware troughs, filled in with pure coal-tar pitch, and protected by a layer of bricks, laid on whilst the pitch is still hot. The drums of H.T. cable are in 500-yard lengths, the transformer kiosks being about 1,000 yards apart. In all, just 6,500 yards of H.T. cable will be laid.

The L.T. cables are also paper insulated, lead-covered and ·05, ·03, ·05 triple-concentric, laid in trenches with a covering of sand and a layer of bricks as a protection. The pressure is to be 400 volts across the outers, and 200 at the consumers' terminals.

The service cables are ·02 concentric, rubber insulation, lead-covered and armoured, so that they can be laid in the ground on private property in comparative safety from the diligent spade of the "darky" gardener, to whom voltage and current do not appeal.

There are six transformer kiosks, manufactured by the British Westinghouse Co., Ltd., of Manchester; they are made in two parts. The base, which is bolted on to a 2 ft. 6 in. concrete foundation, is divided into two compartments containing the high and low pressure switchboards, each compartment being quite separate and having its own door; the H.T. board consists of one panel only, with switchgear and transformer fuses, but the L.T. has three panels, forming three sides of the compartment. These panels are fitted up to connect up four separate L.T. feeders, the busbars at the back being connected to the transformers through a main switch and Wright's demand indicators.

Durban: View of Power Station Buildings and Car-Shed.

The illustrations at the top of this page will give our readers an

idea of cable laying with native labour, and the difficulties met with in trenching, the ground being extremely rocky. For these views we are indebted to Mr. G. K. Nowlan, of the B.I. & H. Cables, Ltd., who has charge of all the cable-laying, his varied experience, partly gained in other Colonies, standing him in good stead in this new Colony.

We are also indebted to Mr. C. E. Wilson, the managing director of the Telegraph Manufacturing Co., Ltd., of Johannesburg, for his kind assistance in the preparation of this article.

In conclusion, we have the utmost confidence in the future of South Africa from an industrial point of view, and the immense possibilities of the use of electricity for every kind of work, will open up a field for home manufacturers in the new Colonies, the schemes in hand at present representing several millions sterling.

DURBAN (S. AFRICA) ELECTRIC LIGHT AND TRAMWAYS.

From a Special Correspondent at Durban.

DURBAN is the seaport of Natal, and excluding Delagoa Bay, which is not in British territory, it has one of the finest harbours in South Africa; it certainly offers better railway facilities for obtaining access to the mining centre of Johannesburg, than any other of the South African ports. Its population two years ago was 28,796 whites, and 31,650 blacks (natives, Indians, &c.), and like most colonial towns it is of large dimensions, its area being 10 square miles.

It will probably be surprising to those accustomed to English returns to know that the revenue of the borough of Durban for last year was no less than £275,000 from all sources. Its municipal debt is £1,500,000, and its rateable value £9,000,000, which may account for the confidence shown in England in the recently floated loan of £300,000. This sum was subscribed twice over, and it is to be partly devoted to the new telephone undertaking, the telephones having lately been purchased from a company. It is scarcely surprising, therefore, with a town of this size and wealth, that electricity has proved of the utmost public service for both motive power and lighting where quick transport is necessary, and where no other public supply of illuminant is in use. This will be seen from the fact that 30 miles of single track for electric trams are either installed or in contemplation, and that approximately 2,000 consumers are taking current for motive power or lighting, in addition to about 200 street arc lamps and nearly 700 incandescent lamps.

The present new combined power station is centrally situated, and close to the railway, from which there is a siding; but before describing this station it will be as well to very briefly mention the old works and plant, which are still supplying a portion of the town for the time being.

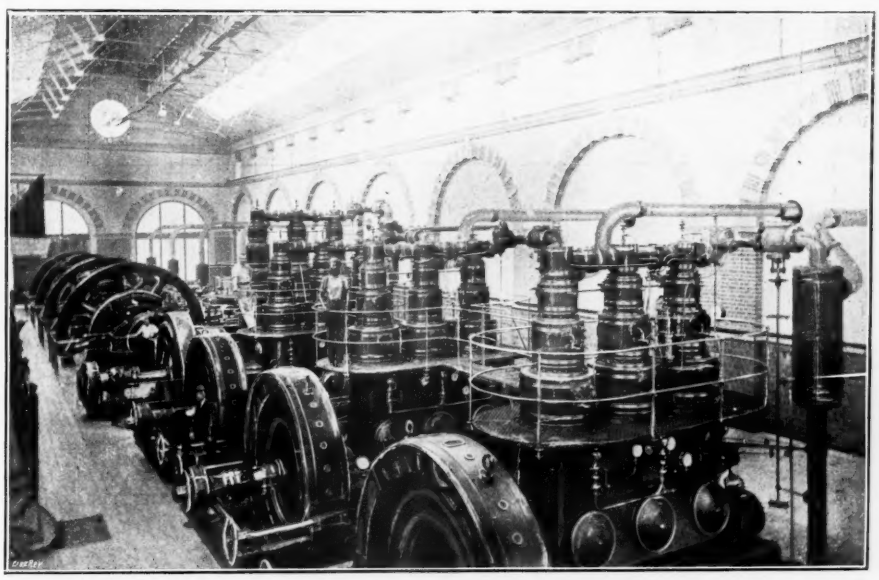
These works are situated at the Point, some two miles from the centre of the town, on which site the destructor and sewage works also existed.

The plant was installed by the Electric Construction Co., of Wolverhampton, under the supervision of the present borough electrical engineer, Mr. T. Roberts, and to the specification of Mr. F. H. Hadfield, of Durban.

Current was supplied by two trunk mains at 2,500 volts alternating, and at 62 cycles to a main sub-station in the centre of the town, whence feeders were run to other sub-stations, being transformed down to 100 and 200 volts to feed the various L.T. mains.

The street lighting was supplied from the well-known type of Thomson-Houston arc machines, Brockie-Pell arc lamps being used throughout.

Four 250-KW. Dick, Kerr traction generators, driven by Yates and Thom horizontal engines.



Three 350-KW. E.C.C. alternators, driven by Willans engines, and one 500-KW. Dick, Kerr-Willans steam alternator — all for lighting supply.

DURBAN: INTERIOR OF POWER HOUSE.

The demand for electric light gradually extended to the Bena, the residential portion of the town, which being a large scattered area was best dealt with by an overhead 200-volt L.T. supply, H.T. underground mains being run to the various street transformers.

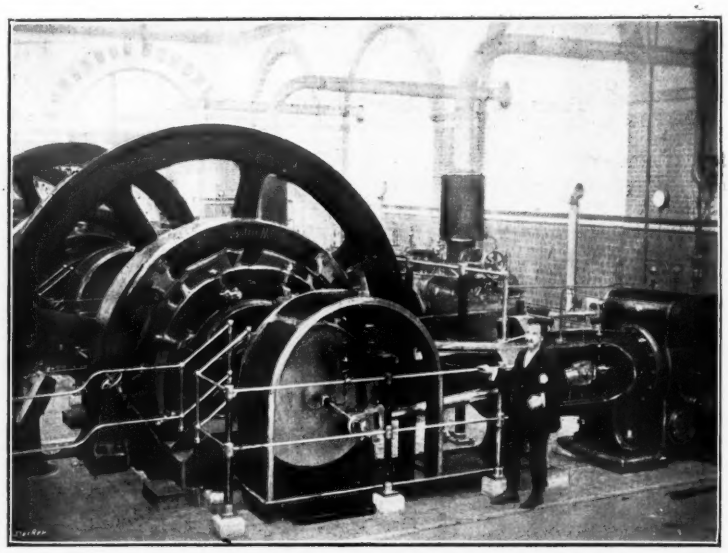
That the original plant and buildings were too small was soon evident, and it was none too soon that a change was made to the present works, for coincidently with the commencement of electric traction there was an abnormal increase in the demand for light, no fewer than 728 new connections having been made during the past year, to meet which large extensions, including new sub-stations and mains, had to be carried out.

The following progress table is interesting, but it is only fair to state that there is no competition in the shape of gas:—

Year ending July.	Applications.	Lamps applied for, 8 C.P.	Units sold for private lighting only, per year.
1898	196	9,320	113,236
1899	357	17,182	226,705
1900	563	26,306	339,196
1901	902	40,830	512,760
1902	1,207	51,789	688,506
1903	2,000	83,757	1,107,265

The power station buildings are of brick, and consist of

boiler and engine room, adjoining which are the usual test rooms, engineers' offices and quarters, also stores and car sheds, leading from which there are the workshops, paint shop, &c. Ample room is left for extensions. The general situation of the premises will be seen from one of our illustrations. Many difficulties had to be contended with in the erection of the buildings owing to the very marshy nature of the ground, and the fact that the boiler-room floor is only about 16 ft. above sea level. The boiler room is 180 ft. long × 50 ft. wide, and at present there are four 250-H.P. Danks's dry-back return tubular boilers, 15 ft. long × 8 ft. 6 in. in diameter, with two flues tapering from 3 ft. 2 in. to 2 ft. 9 in., and 74 4-in. tubes, with 38 sq. ft. grate area and 2,170 sq. ft. heating surface. There are also four 220 nominal H.P. Babcock and Wilcox boilers, and there are about to be installed three Hornsby upright boilers of 730 H.P. each, fitted with superheaters. The boilers are fitted with steam drums, low-water alarms, non-return valves, and the usual fittings, the stoking being done by hand. Each boiler is connected to a common steam main running the length of the boiler room, together with an auxiliary main, and pipes are led through the wall to the engines, which are fitted with separators, and also to the condenser engines. There are two Weir steam feed-pumps, capable of supplying 2,000 gallons of water per hour against a steam pressure of 160 lbs. per sq. in., the supply of water being taken from duplicate town supply mains, or from a large storage tank of some 50,000 gallons capacity, whence it is carried through pipes, running through the oil baths of the Willans engines to cool the same, into a smaller tank in the boiler room, then through the pumps to a Berryman feed heater, heated by the exhaust steam of the condenser engines, and finally through Rankine filters to the boilers. A Green economiser is also provided having 224 tubes, the scrapers for which are driven by a 1-H.P. D.C. motor. The chimney is 120 ft. high, built of steel plates, and lined throughout with fire bricks, the diameter at the top being 9·6 ft. Two large Weir pumps are also being fixed, each with a capacity of 4,500 gallons of water per hour.

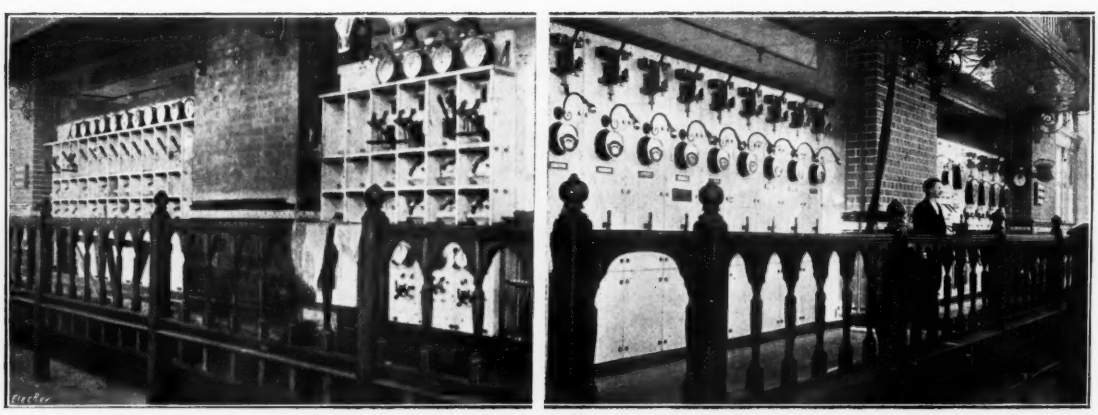


Durban: Traction Generators.

The engine room is 180 ft. long and 50 ft. wide, spanned by a 10-ton hand-travelling crane; the floor of the room is level with the tops of the boilers, and the open condenser pit is about 11 ft. below and between the engines and boilers. The walls are finished with a glazed tiled dado at a height of 7 ft. from the floor, which is also suitably tiled.

There are four traction generators of 250 KW. each, supplied by Messrs. Dick, Kerr & Co., driven direct by cross-compound condensing horizontal engines by Messrs. Yates & Thom, and developing 450 H.P. each, with 160 lbs. pressure, at a normal speed of 100 revolutions per minute. These are shown both in our illustration of the generating station, and in the adjoining view. The engines are fitted with Corliss trip gear on both H. and L.P. sides, controlled by a rope-driven governor, the L.P. side being also adjustable by hand, and the lubrication is effected by an oil pump driven from the engine shaft. The fly-wheels are 18 ft. in diameter, and weigh 14 tons, and the length of stroke is 3 ft.

The dynamos were built at the works of the English Electric Manufacturing Co.; they are of the multipolar direct-current external-field type, compound-wound, having eight poles, and generate current at from 500 to 550 volts. The armature is mounted on the main shaft of the engine, between the H. and L.P. sides; the coils, being laid in open slots on the periphery, are thus easily interchangeable. The frame is of cast-iron, into which are cast the laminated pole-pieces, and the core is built up of steel laminations, spacing laminations being inserted to form ventilating ducts for cooling the interior of the core and the windings.



Durban: Lighting and Traction Switchboards.

The lighting plant consists of three 575-H.P. vertical condensing engines of the well-known Willans type, and one of 800 H.P., direct coupled to E.C.C. and Dick, Kerr alternators respectively of 350 and 500 KW. capacity, and provision is made for a set of 800 KW. capacity of a similar design, which it is hoped to have erected by the end of the year. The engines run at 320 revolutions per minute, the

adjustment of the governor being controlled from the switchboard by means of an electric motor attachment. There are three sets of jet condensers of the well-known Worthington "Independent" type, with combined air and circulating steam pumps; these are connected to the exhaust main common to all the engines, and work in conjunction with three Worthington cooling towers. Two of the condensers deal with 14,000 lbs. of steam per hour each, the two cooling towers in conjunction with these being 32 ft. high × 13 ft. 6 in. in diameter, and the other condenser deals with 23,600 lbs. of steam per hour with a cooling tower 34 ft. high × 13 ft. 6 in. in diameter.

Forced ventilation is used with all the towers by fans driven by Holmes D.C. motors. The condensers are in full view from the engine-room floor, and an automatic by-pass is arranged for exhaust into the atmosphere in cases of emergency.

A new 1,500 H.P. cooling tower is being erected, supplied by Messrs. Cole, Marchent & Morley, Ltd.; it is of large dimensions, and is probably one of the most efficient towers made. The height is 45 ft. × 33 ft. 6 in. × 22 ft., and it is built of pitch pine. It is practically one tower divided into two, with fans on opposite sides to each half. The water is split by rows of laths with saw teeth on the lower edges, laid in rows at an angle of 45°, and deals with 36,000 lbs. of steam per hour. This will be used in conjunction with two 1,000-H.P. jet condensers with Edwards air and circulating pumps.

The traction and lighting switchboards — a view of each of these is here given—were supplied by Messrs. Dick, Kerr & Co. and the Electric Construction Co. respectively, and are arranged in a recess on an elevated platform lengthways with the engine room and facing their respective sets of engines, with a gangway at the back 7 ft. wide, under which the various cables are led in and up to the connections at the back of their respective panels.

The traction switchboard consists of panels for total output, four generators, "B. of T.," booster, rail return, station circuit, and 10 feeder panels. The panels are of polished white marble, carried on a strong iron frame; the total output panel carries positive and negative knife switches, ammeter, and Thomson watt-hour-meter; the generator panels carry positive and negative knife switches, circuit breaker, rheostat, voltmeter plug and ammeter; the "B. of T." panel has the usual recording instruments, and the other panels are also suitably equipped. Each generator and feeder panel is also provided with a lightning arrester and coil. The equalising switches for switching the series coils in, previous to paralleling, are fixed on pedestals near the corresponding generators. The voltmeters are fixed on swing brackets at the end of the switchboard, and are of the illuminated dial type. A double-faced clock is fixed to the bottom of the gallery, in full view from any position on the board. The lighting switchboard is also of polished white marble, mounted on an iron frame, and consists of four generator and two spare panels, and one main and 13 feeder panels; each panel is divided from its neighbour by a marble partition, and is again sub-divided into compartments for the fuses, &c.

The generator panels are provided with oil-break fuses, main double-break switch, ammeter, voltmeter, and synchronising plugs, under which are the exciter panels, which carry shunt-regulating rheostat, ammeter, and "throw-over" exciter switch. The bus-bar at the back of the panels is arranged with insulated screw-in plugs, by means of which any panel can be entirely disconnected. The synchronising transformers are at the back of the switchboard, in duplicate. The alternating meters are of the Kelvin sector pattern, and the exciter ammeters are of the Evershed-Vignoles pattern. A Ferranti H.T. board is now being erected to carry 12 extra circuits. Leading off the switchboard platform there is a testing and repairing room. The workshop building is divided into rooms for meter and arc lamp testing, armature winding, &c. The workshop itself is 81 ft. long × 45 ft. wide, and is equipped with the latest type of machinery, not only for the power station repairs, but for repairs for the various departments of the Corporation, the machinery being driven by D.C. motors.

Adjoining the workshop there is the smithy and foundry, as well as the car-sheds and paint shop, the rails being led inside the last named. The shed is 212 ft. long and 74 ft. wide, and is divided into two bays, with four tracks in one and three in the other, under most of which there are inspection pits running nearly all the length of the shed, with a capacity for 38 cars; another shed of similar dimensions is in course of erection. The car-shed and paint shop are fitted with sprinklers for the prevention of fire, and lighted by both arc and incandescent lamps. An air compressor is used for blowing out the dust in cleaning the cars.

(To be continued.)

ELECTRIC LIGHT AND POWER NOTES.

Aston (Yorks.).—The P.C. is negotiating with the Birley Colliery Co. for a supply of energy for public lighting at Swallownest.

Balby-with-Hexthorpe.—The U.D.C. has requested the Yorkshire Electric Power Co. to quote terms for supplying energy to the town.

Blaydon.—The Priestman Power Co., Ltd., has offered to supply electricity in bulk to the U.D.C.; rent to cover interest, redemption and depreciation on mains &c., to be provided by the Council, the company to do the whole of the work, including the laying of mains, &c. The Council favours the proposal, which is to be considered at its January meeting.

Bodmin.—The Southern District Electricity Corporation has intimated that it proposes to apply to the B. of T. for a prov. order to supply electricity in the U.D.

Brighton.—The T.C. and Steyning East R.D.C. have come to terms in regard to the supply of energy by the Corporation within the R.D.C.'s area. The former has accepted the following conditions:—That the R.D.C. may determine and put an end to the agreement on giving a year's notice, and taking at a valuation all mains and fittings, and that the Corporation shall not oppose any application by the R.D.C. for powers to supply energy.

Cheltenham.—The cost of the electric light installation recently completed at the new Town Hall has amounted to about £1,750.

Clacton-on-Sea.—The B. of T. has intimated to the T.C. that it will not revoke the Council's E.L. order for another year, when notice will be again given to the T.C.

Clevedon.—The U.D.C. after considering the application of the Western Electric Distributing Co., Ltd., for a prov. order for E.L. in the parishes of Clevedon, Portishead and Long Ashton, has decided to interview the promoters on the subject, with a view to the settlement of terms.

East Molesey.—Edmundson's Corporation has, in compliance with the request of the U.D.C., fixed the price of electricity for public lighting at 2½d. per unit. For power, 4d. for the first hour, and 1½d. after, on the maximum demand system. A system of free wiring will be introduced at a rental of 4½d. per lamp per quarter.

Frome.—The U.D.C. on the 3rd inst. received an intimation from the Western Electric Distributing Corporation to the effect that it would be unable to proceed with the prov. order for E.L. during the ensuing session of Parliament.

Germany.—The establishment of a municipal central electric lighting station in the town of Hartha has been decided upon.

Glasgow.—Further proposals have been made in connection with the extension of the lighting department for the amalgamation of that department with the power department of the tramways.

Glastonbury.—At a meeting of the T.C. on December 2nd it was unanimously resolved to apply to the B. of T. for a prov. order for E.L.

Holyhead.—The U.D.C. has resolved to have the contract with the National Electric Construction Co. signed forthwith.

Huddersfield.—The T.C. on 8th inst. decided to apply to the B. of T. during the next session of Parliament for a prov. order authorising the Corporation to supply electricity for public and private purposes within the Golcar U.D.

Ilkeston.—The Corporation Tramways and Electricity Committee has decided to reduce the charge for electricity for lighting purposes from 4d. to 3d. per unit. The department obtains its energy in bulk from the Notts and Derby Power Co.

Liskeard.—Messrs. Thompson Bros., of Plymouth, have made application to the T.C. for permission to run overhead wires for the electric lighting of the main streets of the town.

Loughborough.—The Town Council has adopted an electric lighting scheme for the borough, involving an expenditure of about £18,000.

Leigh.—The T.C. will make application to the L.G.B. for sanction to borrow £8,280 for further extensions of plant during 1904, as follows:—

850-kw. generating set and piping	£3,500
Switchboard	300
	£3,800
Extensions for 1905:—	
One water-tube boiler, piping, &c.	1,500
Mains, services, &c., 1904-5 (estimated)	2,000
Contingencies (10 per cent.)	980
Total	£8,280

London.—Battersea.—The B.C. has resolved to apply for a loan of £3,845 for electric lighting purposes.

Camberwell.—On November 13th the B. of T. heard an appeal from the County of London and Brush Provincial Electric Lighting Co. against a resolution of the B.C. imposing the following conditions in reference to placing a transformer box in Burbage Road:—"Subject to any disturbance of the footway or roadway being made good to the satisfaction of the borough engineer, and subject to an undertaking by the company, that should the site or any portion thereof, or the works connected therewith, be required for public purposes, the company will pay the cost of removal or of any alterations." The Works Committee of the B.C. reported having recently received the award of the B. of T. disallowing the conditions sought to be imposed by them.

Crystal Palace.—The South London municipal authorities interested, are in receipt of a communication from the B. of T. stating that the Crystal Palace District Electric Lighting Co. proposes to sell the undertsking authorised by its orders to the Blackheath and Greenwich Electric Lighting Co., and that in the event of the sale taking place the Blackheath Co. wishes to supply energy on a similar system to that adopted by it for the purposes of its other orders, in lieu of the system now adopted by the Crystal Palace Co. The B. of T. notifies that it is prepared to approve the proposed transfer, subject to a condition that the consumers are paid the reasonable cost of, or expenses incidental to, the change of system, including compensation for any loss or damage incurred in consequence of the change.

Islington.—The L.C.C. has drawn the attention of the B.C. to the desirability of sinking funds for the renewal and replacement of machinery being provided by those municipal bodies who had taken up loans for electrical undertakings for periods of 42 years. It was pointed out that Islington had borrowed £388,081, and up to March last had only paid £20,646 off loans. The B.C., when applying for a loan of £849 for mains extensions, &c., resolved to state to the L.C.C. that any renewals required during the 42 years' life of the loan would be provided out of a sinking fund, or from maintenance account.

Southwark.—The E.L. Committee of the B.C. is to consider a letter from the City of London Electric Lighting Co., Ltd., offering to enter into negotiations to supply electrical energy in bulk.

London County Council.—It was decided at the meeting on Tuesday to sanction the borrowing for electric lighting purposes of £14,145 by the Hampstead Borough Council, and of £10,000 by the St. Pancras Borough Council.

Lynton.—The U.D.C. has complained of the electricity supply provided by the Electric Light Co. The chairman stated that if it did not improve the Council must consider the question of starting in opposition.

Merton.—Wimbledon U.D.C. having received application for energy to 36 houses in the Merton district, and also for a supply for lighting the private roads, the P.C. has been asked if it has any objection to the Wimbledon Council extending its mains to the parish.

Musselburgh.—The Town Council on 1st inst. concluded an agreement with the National Electric Construction Co. for the electric lighting and tramway scheme for the district. Energy will be supplied at the rate of 5d. per unit for domestic purposes, and 2¾d. for public lighting. It was stated that a start will be made at once, as the company intended to have the tramway in full working order before next August. The electric lighting installation will proceed concurrently.

Newbury.—Messrs. Edmundson's Electricity Corporation are appealing to the B. of T. against the request made by the local authority that the cables should be laid in the sides of the roads. The T.C. state that it would be a serious matter for the town if the concrete pavements, which had been recently put down, were disturbed, and it was hoped the B. of T. would support the Council in the matter.

Newquay.—The T.C. has agreed to obtain advice from Mr. H. Dickinson, of Leeds, and Mr. F. H. Lewis, of Leytonstone, as to the proposed electric lighting of the town by the Southern District Electricity Corporation.

Penge.—The U.D.C. has received a communication from the Blackheath and Greenwich Electric Light Co., reporting the completion of the negotiations for taking over the undertaking from the Lewisham and District Electric Supply Co. for the supply of electric light to its district.

Pitlochry.—A scheme has been approved by a meeting of citizens for the electric lighting of the burgh. A private company is to be formed, and the motive power for the generation of energy is to be derived from the Falls of Tummel.

Rotherham.—The T.C. has reduced the price of energy for motive power purposes to 1½d. per unit for the first two hours per day, and 1d. afterwards.

St. Albans.—The Corporation has resolved to apply to the B. of T. for powers to transfer its electric lighting undertaking to the St. Albans and District Electric Supply Co.

Salford.—The T.C. has decided to charge ½d. per unit more than the Salford rate for energy supplied to Prestwich.

Southport.—From January 1st, 1904, the rates to be charged by the Corporation for electricity for power purposes will be reduced to 2d. per unit, and 1½d. per unit if the consumption of energy equals 350 units per B.H.P. installed, with a discount of 5 per cent. No charge is made for meter rent, and service lines up to 60 ft. from the distributing main are laid free. The electrical department also announce that it is prepared to supply motors on a deferred payment system. This should lead to a largely increased consumption of energy for power purposes.

Hoyland.—The U.D.C. has asked the Yorkshire Electric Power Co. to furnish full particulars as to cost, &c., of supplying energy to the town.

Spain.—It is proposed to establish an electric lighting station in the town of Alginet (Valencia).

A concession has been granted to D. Domingo Puerta y Morillas, for an appropriation of 10,000 litres of water per second from the River Tagus, at Sacedon (Guadalajara), for generating electricity for lighting and industrial purposes.

Spalding.—The U.D.C. has decided to postpone the application for a prov. order for the electric lighting of its area.

Wanstead.—The U.D.C. has received notices from Leyton U.D.C. and the Empire Electric Light and Power Co., of their intention to apply for E.L. powers. The Council will withhold its consent to the Empire Co.'s application, and will negotiate with Leyton as to terms, &c.

Watford.—The U.D.C. has resolved to communicate with the North Metropolitan Electric Supply Co. to ascertain whether it would be prepared to acquire the Council's electric light undertaking, and if so, on what terms. Upon the scheme, it may be mentioned, £55,000 has been expended, and it was recently reported that a further outlay of £25,000 would be necessary.

Welshpool.—At Powis Castle, the seat of the Earl of Powys, an electric light installation of 600 lamps has just been completed. The work has been carried out from designs prepared by Mr. G. F. Bodley, R.A.

Widnes.—The T.C. proposes to seek an extension of time in which to carry out the E.L. Order obtained in 1901, also powers to transfer the order.

The Mersey Electric Supply Syndicate has notified its intention to apply for a prov. order for Widnes.

Willesden.—The Urban District Council having considered the proposed sale of the Council's electricity works to the North Metropolitan Electric Power Supply Co., and the draft agreement for the supply of electrical energy, subject to an alteration providing that the scale of prices agreed should not at any time be increased, the Council adopted the recommendation of the Committee by 10 votes to 5.

Yeadon and Methley.—The Yorkshire Electric Power Co. has informed the U.D.C.'s that it is prepared to enter into negotiations for the supply of energy to the Councils' districts from the power house now in course of erection at Thornhill.

ELECTRIC TRACTION NOTES.

Brighton.—An illustration of the way in which it is possible for a few obstructionists to throttle tramway extensions has just happened in connection with the tramways here. On August 6th the Tramways Committee brought forward a resolution to the T.C. suggesting that a provisional order should be applied for in the ensuing session for powers to construct a double line of tramway from the terminus in London Road to the borough boundary at Preston. This matter had previously been reported on by the tramways engineer, who estimated there would be a profit of £912 per annum on this section alone. All went well till it got to the Council Chamber, when it met with a small but determined opposition, but passed. A month later there was a motion on the Council agenda to rescind the previous motion; but this was outvoted. The opposition minority now adopted meaner tactics to attain their ends. As there had to be a statutory meeting to confirm the previous decisions at which two-thirds of the Council (that is, 38 members) had to vote, the opposition organised a "passive resistance" movement of not voting at all. The statutory meeting has been postponed three times on account of there not being the requisite number to vote either one way or the other. Eventually, on Thursday the 4th, the matter had to be dropped altogether, as the "passive resisters" stayed outside the Council Chamber until the vote had been taken. This method of obstructing tramway extensions was evidently not foreseen when the Tramways Act of 1870 was drafted, as in this way it will always be

possible for a minority of 21 to upset the decisions of 38. Had they voted against the scheme in an honest way it would have gone through all right. About a dozen stormy indignation meetings have been held in the town to protest against such underhand methods.

Brussels.—A party of over 100 members of the Société Belge d'Electriciens, Brussels, were conducted over the tramway power station by Mr. Pedriali, the chief electrical engineer of the system, on 4th inst. Among those present was Mr. Léon Gérard, President of the Belgian Institute of Electrical Engineers, who has recently joined the board of the Union Co., of Berlin; Mr. Lacomblé, secretary, who is the electrical engineer-in-chief of the Brussels electricity supply; also Mr. Doms, assistant electrical engineer, and Mr. Welabrandt, chief electrician.

Cardiff.—The Corporation Tramways Committee has decided to apply to the B. of T. for a loan of £70,577 for the reconstruction of part of the electric tramways.

Dewsbury.—The local authorities in the Dewsbury district have received notice from the Yorkshire Electric Tramways Construction Syndicate (a Wakefield company) of their intention to apply for powers to construct a tramway from Dewsbury to Ossett, *vid* Soothill Nether. Two similar applications have been previously refused. The Corporations of Dewsbury and Ossett and the Soothill Nether Urban District Council are also applying for powers to construct tramways along the same route. They are not, however, to be regarded as rival schemes. If the company's application comes on first the two Corporations and the District Urban Council will oppose; but if the scheme promoted by the local authorities is considered first, and falls through, then no opposition will be offered to the company's application.

The Corporation, in accordance with an agreement entered into some time ago, has decided to give notice to the B.E.T. Co. of its intention to purchase the company's electric tramways in the borough. It is stated that the basis of purchase will be the full cost of the lines and equipment, including the company's Parliamentary expenses, plus 20 per cent. When the purchase is completed the Corporation will lease the lines to the company for 28 years, at a rent sufficient to pay the interest and sinking fund on the capital outlay. At the end of the 28 years the company are to have the option of entering into a further lease for seven years on the same terms. Should any difficulty arise between the Corporation and the company in the negotiations, the matter will be referred to the Board of Trade for arbitration.

Derby.—At the monthly meeting of the T.C. last week, Mr. John Smith inquired whether the rails which had been purchased for the new electric trams had not been condemned. They were purchased in Belgium either to assist home industries or to save the rates, and the man in the street wanted to know. Alderman Duesbury (chairman of the Tramways Committee) said as to whether any rails had been rejected, none at all had come to England yet. Mr. Smith: Have you had any condemned in Belgium? Alderman Duesbury: We have a man there to see to them, and he will not pass any unless they come up to the standard, which was a very high one.

Dublin.—At Dublin on Monday, Miss Josephine O'Brien, a dressmaker, who sustained injuries of a permanent character in a collision between two electric trams at Kingstown, was awarded £1,000 damages against the Dublin United Tramways Co.

Italy.—An electrical omnibus service on the Lombard-Gerin system has just been established between Gallarate and Samarate, a distance of 3½ miles. The vehicles have accommodation for 28 passengers.

Lincoln.—The proposed purchase of the tramways by the City Council does not seem likely to be effected without recourse to arbitration. The Corporation and the tramway directors cannot come to an agreement, although only £125 divides the amounts. The matter was discussed at a meeting of the City Council on Tuesday, and regret was expressed that it should be necessary to spend from £1,500 to £3,000 on arbitration proceedings for such a trifling sum as £125. It was evident from the discussion, however, that the Corporation have reached their limit.

London.—The Highways Committee hope to commence the working of the New Cross and Greenwich, &c., sections of the electric tramway system by the end of the year.

Camberwell.—On Saturday the Works and General Purposes Committee of the B.C. reported that they had passed a resolution in favour of consenting to the conditions as to overhead traction and doubling the lines where necessary, required by the L.C.C. before that body agreed to acquire the London Southern Tramways. The same Committee also reported having adopted a motion that the B.C. should contribute one-third of the cost of the street widenings in connection with the proposed line from Lordship Lane to Forest Hill.

Islington.—The Mayor at Friday's meeting of the B.C. announced that the L.C.C. had practically agreed to adopt the conduit system for the North London tramways. It was resolved to advocate before the Royal Commission on London Traffic, tube railways under Holloway Road to East Finchley, from Finsbury Park to Hornsey, and from Islington to Stoke Newington.

L.C.C.—The Highways Committee reported that it might be possible to commence the working of the New Cross and Greenwich lines on the conduit system by the end of the year. It was proposed to communicate with the Board of Trade so as to allow of an official inspection of the completed tramways, and to invite the borough councils interested to be present at the examination.

New York Central and Hudson River Railroad.—This company, which is to use electricity on its lines in the vicinity of New York City, has placed an order with the General Electric Co. for eight turbo-generators of 7,500 H.P. each. The turbines are of the four-stage vertical Curtis type, and the generators are of 25-cycle triphase, generating 11,000 volts. The company has also ordered from the same firm, in conjunction with the American Locomotive Co., 30 electric locomotives of an entirely new design, weighing 85 tons each, with an adhesive weight of 67 tons. The locomotives are to be of 2,200 H.P., and will haul a train of 500 tons at 60 miles an hour. The prices quoted are not made public, but the R.R. Co. has the option of increasing the order at the same rate. The locomotives will be used for express trains only, and it is estimated that their use will effect a slight saving. Hitherto steam locomotives of this character have burnt 5 lbs. of coal per H.P.-hour, but with electricity it is expected to burn only 2 lbs. per H.P.-hour. It is, however, calculated that the axle loss of horse-power with the electric locomotives will be increased 50 per cent., and as the fuel cost is about 8 per cent. of the total operating expenses, a net gain of only 2 per cent. is looked for. It is designed to run the slower suburban traffic on the multiple unit system, each car having its own independent motor, all controlled, however, by one man, thus saving the wages of firemen. It is stated that the news caused the shares of the G.E. Co. to rise six points on the New York Stock Exchange.

Southport.—The Corporation Tramways Committee state that this year the receipts for the year up to November 7th, were £11,500, and the expenses £11,300, or a surplus of about £200. The actual difference in favour of the past half-year's working is £420. Last year the receipts amounted to £10,700, and the expenses to £10,900. It has been resolved that from the 9th inst. the fare on the inner-circle route be reduced to 1d.

South Shields.—At a meeting of the T.C. on the 30th ult., a report of the Tramways Committee was considered. It recommended that the routes authorised by the Act be adopted as the routes of the new tramways, with the exception of the sections from Dean Lane (Westoe), to the borough boundary on the Sunderland Road, and from Green Street *vid* Laygate Lane and Corstorphine Town to Tyne Dock. Several amendments were proposed, but, after debate, all were rejected, and the report was carried. Motion for the leasing of the tramways, and also one giving power to the Committee to proceed with the work, were referred back to the Committee.

Sunderland.—The T.C. has formally approved instructions being given for the obtaining of a prov. order authorising the Corporation to construct lines at Roker and in the centre of the town to make short circular routes to relieve the very congested traffic in those parts, as well as to expedite the tramway service. The cost is put down at just under £4,000.

West Ham.—The last section of the contract for the laying of the municipal tramlines has been commenced. It is expected that the whole route will be completed by February. Fifty bodies of cars have been delivered.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—At a recent meeting of the Telephones Committee the Mayor submitted the correspondence between himself and the Secretary to the National Telephone Co. concerning Councillor Carden's action at Burgess Hill and alleged unfair preference. The town clerk submitted a letter from the Postmaster-General's Department enclosing copy of a letter addressed to the Department by the National Telephone Co. and asking for the Corporation's observations thereon. Mr. Gaine's letter to the Post Office says, among other things:—

"I am directed in particular to call the attention of the Postmaster-General to the fact that not only is money being paid by or on behalf of the Corporation to induce these subscribers to break their contracts with the company, but also that these subscribers are offered a preference over other subscribers in the area inasmuch as the Brighton Corporation is offering to supply them with a free service for a certain period of time. The company is advised that these proceedings by or on behalf of the Corporation constitute a clear breach of the undue preference provisions of its licence, and I am directed to ask that the Postmaster-General will take immediate and effective action in the matter."

The Committee resolved: "That the Postmaster-General be informed that the Council endorse the observations contained in the Mayor's letter to the manager of the National Telephone Co. of the 17th inst., and in addition to what is stated by the Mayor on the subject of the alleged preferential treatment, they would point out that the terms offered to subscribers in the Brighton area are the

same as those given in Portsmouth, Glasgow, Swansea and other towns where Corporation telephones have been established, and by the Post Office Department in the case of London."

Liverpool.—From particulars given by Mr. E. J. Hidden at a meeting of the Liverpool Engineering Society last week, in the course of a paper on "Recent Telephone Developments in Liverpool" read by him, it appears that since the accident in 1901, when a number of telephone wires fell across trolley wires after a snowstorm at Liverpool, the whole of the telephone wires in the city, outside of buildings, have been placed underground. A building has been erected on land in Great George Street as a new relief exchange, which will have switchboards capable of accommodating 10,000 subscribers, and which is claimed to be at the present time one of the finest switch-rooms in the kingdom. The boards are multiple boards, each section being formed to contain the full capacity, viz., 10,000, and being fitted for three operators' positions. Provision has been made throughout the Liverpool switch-rooms to admit of converting the present system to the central battery system with little alteration. By this system current will be supplied from one main battery at the exchange for switch-rooms and for subscribers' instruments, and the practice still followed with many instruments of subscribers having to ring up will be discontinued.

Siemens & Halske Rapid Type-Printing Telegraph.—At a recent meeting of the Berlin Elektrotechnischer Verein, Mr. Wilhelm von Siemens delivered an interesting address on the rapid type-printing telegraph designed by the Siemens & Halske Co. The apparatus, as developed for some years past by the above company, belongs to the class of so-called automatic telegraphs (Pollak-Virag system) where the telegram is prepared by a type-writing device piercing for each letter to be telegraphed, a given hole or set of holes in a continuous paper ribbon. The latter, on being drawn through the rotating telegraphic transmitter, will automatically throw corresponding current impulses into the circuit. As the Siemens apparatus is capable of telegraphing 2,000 letters per minute on a single line, whereas each official even with the best of apparatus cannot transmit more than 200 to 300 letters in the same interval of time, it will be possible to send the telegrams transmitted by a large number of officials through the same line. In the Siemens apparatus, two holes are pierced in the paper ribbon for each letter, the letter being itself printed in plain printing characters immediately above, so that the perforated ribbon contains the telegram in distinctly readable form. Moreover, the public itself will be able to take charge of the perforating, transmitting the prepared ribbons to the telegraph office.

In the receiving apparatus, the ribbon travels at the same speed, containing the telegram in plain printing, ready for sticking on telegram forms. In order to ensure this printing of 2,000 letters per minute without any delicate mechanical apparatus, the electric spark is resorted to. A disc on which the various letters are cut out as in a pattern is rotated at a speed of 2,000 turns per minute between a spark gap and a continuous ribbon of photographic paper. Whenever a spark passes in the gap, a silhouette of the letter happening to be in front of the latter, is projected on the paper ribbon. It should be noted that the spark must be produced with an accuracy as high as $\frac{1}{4000}$th part of a second, in order to have the proper letter appear at the proper place. The paper ribbon next passes beneath some sponges impregnated with developing and fixing liquids, the photographic process requiring only nine seconds, so that the ribbon is delivered ready printed.

The problem of causing the spark to be produced with the utmost accuracy at an instant accurately given in accordance with the current impulses transmitted from the sending apparatus, was solved by utilising the property of electric condensers of being charged and discharged in very short intervals. The mechanism of the apparatus has hence been so simplified that the receiver, apart from the photographic device, is embodied simply by a shaft driven by an electromotor, on which, in addition to the above-mentioned type-disc, only some brushes are mounted, sliding over contact discs. In addition there are five relays of special design, the tongues of which will follow the rapid impulsions without any difficulty and at a sufficient speed. A special and ingenious device causes the receiving apparatus to perform in a given time accurately the same number of turns as the transmitter giving off the current.

Experiments, for which the Imperial Postal Department lent some lines, have shown the practicability of the apparatus for transmissions over great distances. Dr. Dranke, Dr. Thomas, and Mr. Ehrhardt have, through their assistance, contributed to the design of the apparatus.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1903	
St. Lucia-Martinique	May 7, 1903	
Anjer-Kalianda	Aug. 2, 1903	
Cayenne-Pinheiro	Aug. 18, 1903	
St. Lucia-St. Vincent	Sept. 19, 1903	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1903	
Paramaribo-Cayenne	Feb. 26, 1903	
New York-Hayti	April 15, 1903	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Tourane-Amoy	Nov. 10, 1903	
Lagos-Brass	Nov. 14, 1903	Dec. 2.

West Hartlepool and Halifax Telephones.—We are informed that the West Hartlepool and Halifax Corporations have under consideration a scheme of exchange telephony submitted to them by Mr. F. F. Bennett, and are now negotiating an agreement with a telephone manufacturing company for the carrying out of the same.

The Underground Telegraph to the North.—A communication received by the Association of Chambers of Commerce of the United Kingdom gives the following information regarding the progress of the underground telegraph line to the North. The temporary wires in the pipes between Birmingham and Warrington are being replaced by a permanent cable. Seventy miles of this cable have been drawn in, and when the remaining 12 miles are drawn in there will be a permanent underground system between London and Birmingham, Manchester and Liverpool. There are already underground wires between Warrington and Manchester and Liverpool. The laying of the pipes north of Warrington to Carlisle is progressing, and the work will be finished this month. Temporary wires have been drawn in as far as Wigan, and will be continued to Preston. A permanent cable to Carlisle will be provided later. In Scotland it has not been possible at present to undertake more than one section of this work. That section is over the Beattock incline, where the overhead wires are much exposed, and the pipe work is completed. Pipes are also being laid north-eastward from Manchester to Leeds, and temporary wires will be provided, to be replaced later on by a permanent cable. This work will be completed before the end of the financial year.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—December 28th. Coal-handling plant for the electricity works. See "Official Notices" to-day.

Bermondsey.—December 15th. Water-tube boilers, coal plant, piping. See "Official Notices" December 4th.

Canterbury.—Electric wiring for the Kent and Canterbury Hospital. See "Official Notices" to-day.

Enniscorthy.—January 20th. Electric lighting and pumping plant (seven sections), for the Lunatic Asylum. See "Official Notices" December 4th.

Erith.—December 14th. "Assisted" wiring work. See "Official Notices" December 4th.

Fire Alarm Wiring.—December 16th. Messrs. May-Oatway Fire Appliances, Ltd., want offers for wiring several installations in Scotland. See "Official Notices" to-day.

France.—December 13th. Tenders are being invited by the municipal authorities of Brienne-le-Chateau (Aube) for the concession for the public electric lighting of the town. Tenders are to be sent to La Mairie de Brienne-le-Chateau (Aube), whence particulars may be obtained.

Govan.—December 28th. Coal bunkers, conveyor, and electric capstan. See "Official Notices" December 4th.

Hackney.—January 4th, 1904. Feeding and distributing mains. See "Official Notices" to-day.

Harrismith (Orange River).—January 18th. Cables, transformers, switchgear, &c. See "Official Notices" to-day.

L.C.C.—January 19th, 1904. Six electrically-driven three-throw boiler feed pumps for Greenwich power station. See "Official Notices" November 20th.

Oldham.—December 23rd. Motor and heating appliance hiring. See "Official Notices" to-day.

Pontypridd.—December 24th. Free wiring tenders; also tramcars. See "Official Notices" December 4th.

Preston.—December 12th. Traction switchboard and accessories. See "Official Notices" November 13th.

Spain.—December 16th. The municipal authorities of Riveira (Coruna) are inviting tenders until the 16th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamienti de Reveira (Coruna).

Stockton-on-Tees.—December 15th. Motor-hiring proposals. See "Official Notices" December 4th.

Sydney (N.S.W.).—December 30th. Telegraph, telephone, and electric light material for the Deputy Postmaster-General of Sydney. See this column for November 6th.

Sydney (N.S.W.).—January 12th, 1904. Messrs. Preece and Cardew want tenders for :—One or two 600-kw. or one 1,200-kw. three-phase steam alternators with condenser, pipework, motor-generators, transformers, switchboards, &c., and a coal and ash conveyor. See "Official Notices" to-day.

Walthamstow.—January 1st. Permanent way, gas plant, engines, dynamos, batteries, switchboard, cables, overhead equipment, &c., for 11 miles of line. See "Official Notices" December 4th.

Warrington.—December 14th. A year's supply of earthenware ducts. See "Official Notices" December 4th.

CLOSED.

Blackpool.—The British Westinghouse Co. has placed an order with Messrs. Browett, Lindley & Co., Ltd., for a 650-H.P. triple-expansion engine, for this Corporation.

Brighton.—After a long debate on December 3rd, the T.C., by 18 votes to 11, decided to accept the tender of Dick, Kerr and Co., Ltd., of Preston, for the whole of the 20 cars at £10,200. The Committee had recommended that an order for 10 cars should be given to the Brush Electrical Engineering Co., Ltd., at £5,085.

Brighton.—The T.C. has accepted the tender of the Ericsson Bell Telephone Co., for an extension of the switchboard to 2,088 subscribers, and 40 junction lines at £2,205.

Bristol.—The tender of Messrs. Dick, Kerr & Co. for the supply of a continuous-current dynamo has been accepted by the Electrical Committee.

Hastings.—The T.C. has accepted the tender of Cowans, Ltd., for a set of Andrews' duplicate mains apparatus at £126.

Salford.—The T.C. electricity department has accepted the following tenders:—

ewarts & Lloyds, Ltd., for tubes and fittings.
nchor Cable Co., Ltd., for leadless cables.
Callender's Cable & Construction Co., Ltd., for compound for H.T. joints.
Howard Conduit Co., Ltd., for bitumen and asphalte troughing.
D. Firth & Son, for an electric light installation at the Central Electric Car Shed, Pendleton.

Swansea.—The following tenders were received on December 3rd by the T.C. for the construction of the electric tramways in the town, and to the suburbs of Sketty, Brynmill and Port Tennant:—

Dick, Kerr & Co., Ltd., Preston (accepted)	£70,406
Blackwell & Co.	72,742
J. G. White & Co.	72,997
W. Griffiths..	73,715
Underwood & Co.	73,327

The Council also accepted the tender of Dick, Kerr & Co. for the electrification of another section of the tramways at £11,345, and that of Callender's Cable & Construction Co. for cables at £19,169. A German firm tendered at £17,717.

Swindon.—The T.C. has accepted the following tenders:—

Messrs. J. G. White & Co., Ltd., steel poles, overhead line, &c.	£4,164	8	7
British Westinghouse Co., Ltd., traction switchboard ..	750	0	0
British Insulated & Helsby Cables Co., Ltd., tramway feeders, &c. (including a two years' maintenance) ..	1,190	9	0

Todmorden.—The Corporation has accepted the tender of Messrs. Bruce Peebles & Co., Ltd., for one 150-KW. steam set, one 75-KW. steam set, and one balancing booster set.

War Office.—The tender of Messrs. Bruce Peebles & Co., Ltd, has been accepted by the War Office, for two 400-H.P. slow speed continuous-current generators, 100 revolutions, directly coupled to Robey engines.

Wednesbury.—The Corporation has accepted the tender of the National Electric Construction Co., Ltd., of London and Wolverhampton, for supplying and fixing the electric wiring and fittings in the Town Hall, the municipal offices, the Art Gallery, Public Baths and Free Library at the sum of £465.

Westinghouse Contracts.—The British Westinghouse Co. has sold to the Maidstone Corporation, through Messrs. Davey, Paxman & Co., two 150-KW. shunt-compound generators for coupling to Messrs. Davey, Paxman's engines of corresponding size. These generators will deliver 300 amperes at 460—500 volts as shunt machines, and 275 amperes at 500—550 volts as compound machines. They will thus be available for either lighting or traction.

The London United Tramways have given a further order to the British Westinghouse Co. for sub-station plant, including two 250-KW. rotary converters, seven 100-KW. oil-insulated self-cooling transformers, a switchboard for the control of the above apparatus, and the necessary details. A large number of rotary converters are now going through the Westinghouse shops, including 500, 800, 1,200 and 1,500 KW. units for, *inter alia*, the District Railway, Metropolitan Railway and North-Eastern Railway.

The Power Gas Corporation, Ltd., has recently placed an order with the same company for two 250-H.P. 3-cylinder single-acting producer gas engines, direct coupled to direct current generators of equivalent power. The engines will be installed at Dudley Port.

FORTHCOMING EVENTS.

Friday, December 11th.—At 8 p.m. Physical Society. Meeting Papers: "The Simmance-Abady 'Flicker' Photometer," by Messrs. Simmance and Abady; "Exhibition of a Conductometer," by R. Appleyard.

Friday, December 18th.—At 8 p.m. Holborn Restaurant (King's Hall). Smoking Concert of the Electro-Harmonic Society, Mr. A. P. Trotter in the chair.

Saturday, December 12th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting.

At 7.30 p.m. Glasgow Technical College Scientific Society. "Steam Turbine Machinery," by A. A. Wynne.

At 8 p.m. Electrical Trades Union. Smoking concert at Holborn Town Hall.

At 7.30 p.m. West Hartlepool Scientific Society. "Mr. D. B. Morrison's Scheme for the Advancement of Apprentices," by Wm. Kennedy.

At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting at Newcastle.

Monday, December 14th.—At 7.30 p.m. Institution of Mechanical Engineers (Graduates' Association). Paper by H. Baker on "Main and Auxiliary Steam Pipes for Power Plants."

Tuesday, December 15th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Paper on "Electric Traction with Alternating Currents," by A. C. Eborall.

Wednesday, December 16th.—At 8 p.m. Society of Arts. Sir Wm. H. Preece on "Science and Industry."

At 8 p.m. Liverpool Engineering Society. Paper on "Polyphase Working," by H. W. Wilson.

At 7.30 p.m. Institution of Electrical Engineers (Birmingham). Prof. R. Threlfall, F.R.S., on "Testing of Electric Generators by Air Calorimetry."

Thursday, December 17th.—At 8 p.m. Institution of Electrical Engineers. Paper by P. V. McMahon on "The City and South London Railway: Working Results of the Three-Wire System applied to Traction, &c."

At 7.30 p.m. Institution of Electrical Engineers (Leeds). Paper on "Methods of Charging for Electrical Energy," by E. H. Crapper.

Saturday, December 19th.—At 3 p.m. Junior Institution of Engineers. Visit to the Walthamstow U.D.C. Electricity Works.

NOTES.

Fiscal Policy.—Business men of the electrical industry are as much divided on the Fiscal Question as other sections of the business world, and the meeting of the Tramways and Light Railways Association, which is to be held at 8 o'clock to-night in the rooms of the Society of Arts, promises to be a lively one. Mr. Atherley-Jones, K.C., M.P. (the President of the Association), is to read a paper and submit a motion in support of the Free Trade view; while others, leaders of the electrical industry, are expected to support Mr. Chamberlain's policy. Sir Charles Rivers Wilson, G.C.M.G., is to preside. Many other men of note who are connected with tramways are also expected to take part in the debate which will end with a division.

Royal Commission on London Locomotion.—The Royal Commission on Locomotion resumed its sitting under the chairmanship of Sir David Barbour at the Westminster Palace Hotel on Thursday last week.

Mr. A. Harrison, A.M.I.C.E., borough engineer and surveyor of Southwark, advocated the removal of costermongers and other obstructions from main roads and the provision of secondary streets for the relief of traffic. He thought the statutory powers now possessed by the Borough Councils over public highways should not be curtailed. The dangerous state of the roads in his district had been considerably enhanced by the running of the electric tramways of the L.C.C. in the London Road, Newington Butts, and Kennington Park Road.

In answer to the chairman, witness said his Borough Council wished to retain the veto on tramways. They knew the requirements of the district, and would exercise the veto with great care. It was better for them to have the veto than to have to go to Parliament to oppose Bills. In answer to Lord Ribblesdale, witness said that he considered the London County Council was in the same position as a tramway company. The L.C.C. naturally looked to make their tramways pay, and would disregard other considerations and would force any scheme they had through. Answering Sir J. Dickson-Poynder, witness said that where there were stopping places and crossings, the tramways impeded other traffic, but not where there was a continuous line of tramline and no stoppages.

Mr. Norman Scorgie, borough engineer of Hackney, said that to abolish the power of veto would mean that the London County Council might proceed with any unwise proposal without consulting the road authorities. Witness further stated that there was an absolute necessity for increased means of communication between the City and the North-east of London, and his Council supported the proposals of the North-East Suburban Railway, which would have opened up Waltham and Chequers Green for the working classes.

The Commission sat again on Friday last, when Mr. Levey, borough councillor, of Hammersmith, gave evidence. He pointed out the great congestion which existed in the district, principally in King Street, the Broadway, and Hammersmith Road, where the electric tramways of the London United Tramway were running, and in which streets were the terminal stations of the Central London Railway and the Metropolitan District Railway. These roads required to be widened. Provision was made for the widening of Hammersmith Broadway in the London County Council's Tramways Act of 1903, in connection with the running of tramways across the thoroughfare. If, however, the contemplated tube railway from Hammersmith to Piccadilly was constructed, and a terminal station was placed in the Broadway, as had been suggested, a further widening might be necessary, in which case the promoters of the railway should be required to bear the cost thereof. The congestion in Uxbridge Road might possibly be relieved by a re-arrangement of the tramway terminus, and it would undoubtedly be lessened by an extension of the Central London Railway in a half circle to near Hammersmith Broadway. Witness suggested the provision of more trains by the North and South Junction Railway and by the South-Western Railway, and also further facilities to the City by the construction of an underground electric railway between Hammersmith and the City, *vid* Kensington, Knightsbridge, Piccadilly and Charing Cross. Replying to Sir F. Hopwood, witness said the question of the tramway termini being on private land had not been before his Council. There was no doubt that the electric tramways caused congestion of traffic, although they served a very useful purpose. If a tribunal were appointed to deal with the traffic question he thought his Council would not object to surrender their tramway veto. Evidence was also given by Mr. J. Patten Barber, the borough engineer of Islington, and Mr. Alderman Eve, of Stoke Newington.

School-leaving Certificates.—A conference was held on Friday last at the Westminster Palace Hotel, S.W., between the Consultative Committee of the Board of Education and representatives of the following professional bodies :—

General Council of Medical Education of Registration.
Institute of Actuaries.
Institute of Bankers.
Institute of Chemistry.
Institution of Civil Engineers.
Institution of Electrical Engineers.
Institution of Mechanical Engineers.
Pharmaceutical Society.
Royal Institute of British Architects.
Society of Accountants and Auditors.

The subject of discussion was the desirability and feasibility of the introduction of a system of school-leaving certificates for England.

Electro-Chemical Industry—Chemical Trade War Ended.—The Northwich correspondent of the *Financial Times* says that it has been ascertained authoritatively that the trade war between English, German and American manufacturers of bleaching powder, which has severely depressed the industry during the past 12 months, has been ended, a working agreement having been arranged. "The effect of this is already evident, the price of bleaching powder having risen to from £4 to £5 per ton, as against anything from £2 upward. The companies which have suffered most severely from the war are the Electrolytic Alkali Co., Castner-Kellner Alkali Co., and the United Alkali Co."

The Late Sir Frederick Bramwell.—On Friday last, at St. Margaret's Church, Westminster, a memorial service, which was attended by a very large and distinguished company of engineers and scientists representing the great institutions and societies with which Sir Frederick had been identified either as president or member, was held. The service, which was simple and very impressive, was arranged for by the Institution of Civil Engineers, of which Sir Frederick was at one time president. The Dean of Westminster officiated, and he was assisted by Canon Henson. The funeral took place at Hever Churchyard, near Edenbridge, Kent, the same day.

We are informed that the business of "Bramwell & Harris" will be carried on as heretofore at 5, Great George Street, Westminster, and also at the firm's offices at Edinburgh and at Cardiff. The name of the firm will remain unchanged.

Institution of Electrical Engineers' Dinner.—The fifteenth annual dinner of the Institution took place on Wednesday evening last, the President, Mr. R. K. Gray, in the chair, and was by far the most successful of these popular reunions that has ever been held. The company numbered close upon 500, and included a large number of guests distinguished in engineering, pure and applied science, art, diplomacy and commerce. The guest of honour was undoubtedly M. E. Hospitalier, President of the Société Internationale des Electriciens, who, on rising to respond to the toast of his health, was received with an enthusiastic ovation which seemed well-nigh endless. The entertainment was all that could be desired; the speeches were brief and happily worded, and the adjournment for social intercourse which followed was availed of to the utmost. Doubtless this feature of the programme, which was introduced for the first time last year, accounts for the greatly increased attendance—an increase of nearly 50 per cent.! Further particulars will be given in our next issue.

Yesterday was noteworthy in the annals of the Institution for the celebration of the 300th anniversary of the death of Dr. William Gilbert, of Colchester, by the presentation of a painting, showing Dr. Gilbert before Queen Elizabeth, to the Borough of Colchester. The account of this ceremony must also be deferred to our next issue.

Personal.—The Gloucester Tramways Committee recommended the appointment of Mr. Edwin Edwards, A.M.I.E.E., of Bradford, as general manager of the electric tramways; 116 applications were received, and six candidates were selected to attend before a sub-committee on Monday last.

The employés of the Yarmouth and Gorleston Tramway Co. have presented an enlarged portrait of himself to Mr. G. Wright, on his retirement from the position of manager.

A Novelty in Underground Conduits.—We recently had the pleasure of inspecting a novel and interesting piece of conduit work, which was being carried out by Messrs. Berry, Skinner and Co., at the Neasden power station of the Metropolitan Railway Co. The system employed, after the preliminary excavation of the trenches, is to lay a foundation of concrete, on which are arranged a row of light steel pipes, kept in position by suitable wooden templates. The pipes are in 7 to 12 ft. lengths, the ends being screwed into each other without any increase in diameter at the joints, and, after receiving an insulating coating, consisting of a mixture of graphite and paraffin wax, to a thickness of about ⅛ in. (preliminary to being placed in position), the steel pipe line forms one continuous smooth tube.

The fixing of a layer of pipes in position is followed by the ramming of concrete in between, successive layers being dealt with in the same way, and the whole is allowed to set for two or three days. Steam is then passed through the pipes, and melts off the insulating and, at the same time, the lubricating coating, thus enabling the pipes to be drawn out, and leaving a continuous duct from end to end.

Experience has proved the feasibility of withdrawing lengths of 50 or 60 yards with ease, and lengths of 120 yards can be negotiated between manholes by drawing out 60 yards of pipe from each end.

Curves can be negotiated without a manhole when necessary, and it is claimed that the system is an advance on those at present in use. The solid homogeneous concrete cable way is also claimed to be strong enough to bridge over subsidences of the sub-soil, and thus to diminish the difficulties usually met with in withdrawing cables from earthenware ducts after subsidences. As the whole of the work is built up on the site, the question of transport and breakage in transport is entirely obviated. We understand that this system of conduit work has met with an extended and successful use, both on the Continent and in America.

Lectures.—At a meeting of the Leeds and Yorkshire Architectural Society on December 3rd, Mr. Edwin C. Wallis, A.I.E.E. (a vice-president of the National Association of Electrical Contractors) lectured on "Electrical Work as Affecting Architects."

At a recent meeting of the Helensburgh Scientific and Literary Association, Mr. Hugh Sheddon on 30th ult. read a paper on "Practical Telegraphy."

The University of London.—It is announced that a gentleman, who wishes to remain anonymous, has given, through Prof. Starling, the sum of £50,000 to University College, London, to be used by the Council of the College for the promotion of higher scientific education and research at that institution.

Electro-Harmonic Society.—On Friday, December 18th, the next smoking concert of this society will be held at the Holborn Restaurant. Mr. A. P. Trotter will preside.

Obituary.—We much regret to have to record the death of Mr. J. W. Curra, Technical Officer in the Engineer-in-Chief's Office, General Post Office. Mr. Curra, who entered the service in 1881, was appointed in 1893 to the position which he held up to his death. He was well known as a most able officer, and his premature decease is deeply felt by his colleagues in the Department.

Fog Dispersion.—Mr. J. W. Bradley, borough engineer of Westminster, reading about Sir Oliver Lodge's experiments on fog dispersion, wrote to the Professor to ascertain whether the street arc lamps could be utilised for the discharge of electricity in the streets for that purpose. Sir Oliver's reply was published in the *Times* on the 8th inst.; he explains that the difficulty lies in the insulation, as a pressure of 100,000 volts was used in his experiments, while the power required is trifling. A much lower voltage would do in the neighbourhood of walls or other earthed surfaces. Sir Oliver considers that the right remedy for fog lies in the suppression of smoke, but he believes that something might be done in the way of fog dispersion, pending reform in our methods of combustion.

THE CENTRAL STATION ENGINEER.

The Brighton T.C. has increased the salary of Mr. Marsh, assistant tramway engineer, to £4 per week.

Mr. S. Whitehouse, of West Bromwich, has been appointed sub-station assistant by the Walsall Corporation, in place of Mr. B. Walker, who has resigned.

Mr. L. B. Hogarth, assistant engineer City of Hull electric lighting station, has been appointed assistant engineer to the Ebbw Vale Steel and Iron Co., Ltd. (S. Wales.)

NEW COMPANIES REGISTERED.

Durham and District Electric Traction Co., Ltd. (79,285).—This company was registered on November 30th, with a capital of £30,000 in £1 shares, to carry on the business of carriers of passengers and goods, electric and general engineers, electricians, contractors, wharfingers, agents, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, mechanical and chemical engineers, suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam, oil or otherwise, &c. The first subscribers (each with one share) are:—W. J. Greer, 58, South Eaton Place, S.W., director; G. J. Somerville, Donington House, Norfork Street, Strand, W.C., electrical engineer; H. S. Day, 33, Smith Square, S.W., director of Tynemouth Electric Traction Co., Ltd.; C. L. Robertson, 14, Vicarage Gardens, Kensington, W., director; A. B. Gridley, 15, Worsley, Hampstead, N.W., secretary; G. O. Hor, Donington House, Norfolk Street, W.C., electrical engineer; and C. H. Godward, Donington House, Norfolk Street, W.C. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, one share; remuneration, £50 each per annum, and 5 per cent. of the dividend paid on ordinary shares, divisible. Registered office: Donington House, Norfolk Street, W.C.

Electrophone, Ltd. (79,302).—This company was registered on December 2nd, with a capital of £15,000 in 10s. shares, to acquire the undertaking known as "Electrophone, Ltd.," to adopt an agreement between the said old company and A. Anns and H. S. J. Booth (the liquidators thereof) of the first part, the National Telephone Co., Ltd., of the second part, and this company of the third part, to manufacture and deal in telephone and all apparatus, appliances, implements, works and things connected with telephonic communication, or with the generation, distribution, supply, accumulation and employment of electricity, &c. The first subscribers (each with one share) are:—F. E. Dommersen, 70, Sotheby Road, Highbury Park, N., accountant; P. Warnford Davies, 62½, Fore Street, E.C., manufacturer; N. E. Maltass, 61, Burlington Road, W., insurance manager; E. B. Koopman, 4, Denman Street, W., merchant; N. W. Russ, 11, Queen Victoria Street, E.C., electrical engineer; A. Butts, 37, St. Mary's Mansions, Maida Hill, W., director; and G. S. Beeching, 45, Upper Baker Street, N.W., stationer. No initial public issue. The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first; remuneration as fixed by the company.

ELECTRICITY SUPPLY ACCOUNTS.

Wrexham Municipal Electric Supply.

The Wrexham undertaking has made considerable progress in output during its second year, the units sold having increased by 52 per cent. Unfortunately, the percentage of works cost to revenue has risen substantially, and this, coupled with a decreased revenue per unit, has tended to diminish the gross profit for the year. The department cannot hope for a very extended lighting business, and its exceedingly poor load factor would suggest the necessity of closer attention to motive power supply which is as yet practically untouched. The charges are:—For private lighting, from 6d. to 4½d., according to quantity; for power, 3d. to 1¾d. per unit. Mr. W. Sillery is the resident electrical engineer.

GENERAL STATEMENT.

For year ending March 31st—	1903.	1902.
Total capital expended	£23,416	£21,178
Number of units sold—		
Private supply	79,425	46,924
Public lighting	53,390	40,042
Total number of units sold	132,815	86,966
Equivalent No. of 8-c.p. lamps connected	9,800	—
Number of public lamps	44	43
Maximum load in kw.	350	150
Revenue account—		
Gross revenue	£2,414	£1,866
„ expenditure	£1,664	£1,134
„ profit	£750	£732
Average price obtained—		
Private lighting...	4·84d.	5·57d.
Public lighting	3 24d.	3·79d.

REVENUE ACCOUNT.

1903.	Gross.	Per unit.
By sale of energy	£2,283	4·13d.
Sale of cable, lamps, &c., fees and premiums ...	131	·23d.
Gross revenue	£2,414	4·36d.

COSTS OF PRODUCTION.

	Gross.	Per unit.
Coal	£173	·31d.
Steam from destructor	150	·27d.
Oil, waste, water and engine room stores ...	98	·18d.
Wages incurred in generation and distribution	280	·50d.
Repairs and maintenance of buildings, machinery and plant, cost of wiring materials, &c. ...	490	·89d.
Works and distribution costs	£1,191	2·15d.
Repairs, attendance, &c., public lamps... ...	122	·22d.
Rents, rates and taxes	33	·06d.
Management expenses, salaries of engineer and clerical staff	239	·43d.
General establishment charges, insurance, law, printing, and stationery	79	·14d.
Total works costs	£1,664	3 00d.

PROFIT STATEMENT.

To interest on loans, bank overdraft, &c.	£738
Sinking fund for loan repayment	572
Deficit on year's working	—560
Gross profit	£750

The gross profit for the year is only some £18 in excess of last year's amount, financial charges are higher, and as a result the deficit amounting to £560 is somewhat greater than in the previous year.

Halifax Municipal Electric Supply.

The returns of the Halifax undertaking for the past year show a rapid return to the profitable working conditions of 1900-1. During the year the department has earned an increased revenue, by some £4,430 over the previous year—with some £500 only, increase in working expenses, and the gross profit has advanced correspondingly.

Following on the comparatively small increase in working expenses, the cost per unit shows a satisfactory decrease of ¼d., and now stands at 1·22d. The position of the undertaking during the past few years will be gathered from the following figures:—

Year	Units sold.	8-c.p. lamps connected.	Income.	Expenditure.	Surplus.
1899-1900	1,371,333	45,403	£16,069	£10,580	£5,489
1900-1	1,896,667	58,770	19,082	14,742	4,340
1901-2	2,557,548	71,210	24,731	24,031	700*
1902-3	3,187,369	81,562	29,162	24,189	4,973

* £1,755 transferred to sinking fund suspense account in 1901-2.

The prices charged are:—For private lighting, 3d. to 4d. per B.T.U for lighting purposes according to consumption, and 2d. per B.T.U. for power, with discount. For tramways, 1$\frac{11}{16}$d. per unit net. Mr. W. M. Rogerson is the borough electrical engineer.

GENERAL STATEMENT.

For year ending March 31st—	1903.	1902.
Total capital expended	£214,057	£200,466
Number of units sold—		
Private supply	758,892	616,072
Traction	2,329,183	1,864,107
Public lighting	99,294	77,369
Total number of units sold	3,187,369	2,557,548
Equivalent No. of 8-c.p. lamps connected	81,562	71,210
H.P. of motors connected	294 H.P.	—
Number of public lamps	69 arc 100 inc.	65 arc 120 inc.
Maximum load in kw.	2,143	1,650
Revenue account—		
Gross revenue	£29,161	£24,731
„ expenditure	£16,193	£15,691
„ profit	£12,968	£9,040
Average price obtained—		
Private lighting	3·5d.	3·44d.
Public lighting	3d.	3d.
Traction	1·7d.	1·87d.

REVENUE ACCOUNT.

1903.	Gross.	Per unit.
By sale of energy	£28,673	2·16d.
Meter, motor and property rents, &c.	488	·04d.
Gross revenue	£29,161	2·20d.

COST OF PRODUCTION.

	Gross.	Per unit.
Coal	£5,979	·45d.
Oil, waste, water and engine room stores ...	978	·08d.
Wages incurred in generation and distribution	2,492	·19d.
Repairs and maintenance of buildings, machinery, and plant...	2,774	·21d
Works and distribution costs	£12,123	·93d.
Rent, rates and taxes	1,547	·11d.
Management expenses, salaries of engineer and clerical staff	830	·06d.
General establishment charges, insurance, law, printing and stationery...	1,593	·12d.
Total works costs ...	£16,193	1·22d.

PROFIT STATEMENT.

Interest on loans, &c.	£6,972
Sinking fund	1,023
Balance transferred to renewals fund ...	4,973
Gross profit ...	£12,968

On the year's working the department earned a gross profit of £3,900 in excess of the previous year, and this, after meeting financial charges, leaves a surplus of £4,973, which was transferred to the renewals fund, which now has a balance of £7,698 standing to its credit.

CITY NOTES.

India-Rubber, Gutta-Percha & Telegraph Works Co.

The directors' report for the year ending September 30th, 1903, to be presented at the meeting to be held at 106, Cannon Street, E.C., Tuesday, December 15th, at 12 noon, reads:—

The accounts show, after provision for doubtful debts, a net profit for the past 12 months of £54,568 16s. 3d. Adding £62,361 11s. 7d. brought forward, and deducting £12,500 interim dividend paid in June, there remains a disposable balance of £104,430 7s. 10d. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in June, a total payment of 10 per cent. for the year, and leaving £66,930 7s. 10d. to be carried forward. The general business shows a falling off when compared with last year. To a great extent this is due to the general depression existing in trade, as a result of which competition has been, if anything, keener than usual. The cable to connect San Francisco with the Sandwich Islands, referred to in the last report, was laid for the Commercial Pacific Cable Co. by our cable steamer *Silvertown* on January 1st last. The *Dacia* and the *Buccaneer* have been employed in cable repairing work during the year. The works at Silvertown and Persan have been maintained in their usual state of efficiency, and extensions continue to be made. The company's Act for the amendment of the memorandum of association received the Royal Assent on June 30th last. The ground lease for a term of 28¾ years of Cannon Street premises has been purchased. The company holds a considerable interest in the Palmer Tyre, Ltd., and has designed a new motor tyre which attracted a good deal of attention at the recent Stanley Show.

The directors regret to report the death of their much esteemed colleague of 20 years' standing, Mr. Abraham Scott, which took place on the 19th ult. Mr. Thomas John Lloyd passed away on December 24th, a year ago. Mr. Lloyd had been connected with the company since its formation in March, 1864, and had been promoted from one post to another until he occupied the position of secretary and accountant at the time of his death. Mr. A. P. Crouch and Mr. E. C. Geale have been appointed respectively secretary and accountant. Mr. John Bailey, also connected with the company since its formation and who was for about 35 years the works manager at Silvertown, has retired from active service as from October 1st last, a retirement well earned after a long period devoted to the company's interests. Mr. Bailey was succeeded by Mr. P. M. S. Brodie, who has been with the company since 1872. Colonel A. Weston Jarvis, having returned from military duty in South Africa, was re-appointed a director, and Mr. John Young Buchanan, became an extraordinary director. Major Leonard Darwin and Mr. Charles H. Moore retire by rotation, and offer themselves for re-election.

Nernst Electric Light, Ltd.

The directors' report to be presented at the fourth annual meeting on Tuesday, December 15th, at the Westminster Palace Hotel, at 2.30 p.m., reads:—

The directors have pleasure in submitting the report and balance-sheet for the year ended September 30th, 1903, showing the profit resulting from the first complete year's trading. The return of lamps sold in the company's districts as well as in England, during the period under review, shows an increase, and the working expenses have been further reduced. As the experimental shops and laboratory have been closed, owing to the altered policy of the company, the directors acting on the advice of their auditors, have added the sum which previously appeared on the balance-sheet under these headings to the development suspense account, which thus stands at £17,355 1s. 1d. As it is clear that a considerable proportion of the above will have to be met before future profits can be distributed, the directors are of opinion that the balance is not available for dividends. The board consider that the shareholders would be acting wisely in reducing the capital of the company, so that it might represent more accurately the available assets. As already announced, the scheme formulated by a section of the shareholders commends itself to your directors as an equitable basis for distribution between the two classes of shares. The directors regret to announce the retirement of Mr. Hugo Hirst from the board; Mr. R. J. Wallis-Jones and Mr. A. M. Oppenheimer have been elected as directors. The retiring director is Mr. J. G. Dalzell, who offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and being eligible, offer themselves for re-election.

Power-Gas Corporation, Ltd.

The meeting of this company was held on 3rd inst. at Westminster Palace Hotel.

Sir Henry H. Fowler, M.P., in moving the adoption of the report, said that the corporation were securing considerable contracts both in this country and abroad for new installations, and extensions of existing installations, under their patents. The practical result of the accounts was to show a profit on the year's business of £13,082. The board proposed to pay £2,000 off preliminary expenses, to pay a dividend at the rate of 5 per cent. per annum upon the ordinary shares, absorbing £9,388, and to carry forward £1,693—a slight increase on last year's figure. The company's progress was slow. The engineering world was waiting to see the result of plants that had been started and to see the probabilities of the greater development of large gas engines. The company's managing director had reported that it was gratifying to see that many important firms in this country had now entered the field of the manufacture of this class of engine, and a great deal of the company's prosperity depended upon their success.

Electric and General Investment Co.—Interim dividends have been declared as follows:—At the rate of 6 per cent. per annum on the preference shares for the six months ending 31st inst., being 3s. per share, and at the rate of 10 per cent. per annum on the capital paid up on the ordinary shares, being 1s. per share for the six months.

Stock Exchange Notice.—The Committee has appointed Wednesday, December 16th, a special settling day in:—Havana Electricity Co., Ltd.—15,000 shares of £10 each, £8 paid, Nos. 1 to 15,000, and has ordered same to be officially quoted.

British Electric Traction Co.—The directors have declared the interim dividend to September 30th last, on the ordinary shares, at the rate of 6 per cent. per annum, being the same rate as in preceding years.

STOCKS AND SHARES.

Wednesday Evening.

Now that the Stock Exchange has entered upon the final settlement of the year—a settlement embracing the Christmas holidays—the chief feature of interest is how steady prices can be kept over what is the most difficult part of the year as regards money. The revival in business promised for the current month is once more dated forward, but members of the House whose lines lie in investment departments are not grumbling as much as usual about the absence of orders, and in spite of the disappointing nature of the Board of Trade returns, the public shows a little disposition to look more favourably upon Industrial and similar securities. For this the high yields obtainable in so many cases are, no doubt, partly responsible, while a certain measure of satisfaction is also felt at the knowledge that Government borrowing in connection with the recent war has just come to an end with the payment of the final instalment upon the Transvaal 3 per cent. guaranteed loan.

In the Electricity Supply section, City of London Ordinary are another ¼ up, having gained the fraction that Charing Cross has lost. Notting Hill shares advanced ½ on dividend considerations, and Westminsters are inclined to rise by reason of the attention that is being directed to the cheapness of the shares as an investment. Metropolitans continue at 18, unmoved by the petition that is being circulated in Marylebone with the object of in some way evading the payment due to the company by the borough authorities under the terms of the recent arbitration award. In the market this agitation is regarded with astonishment, the view being taken that, having agreed to arbitration as the best way for settling a very delicate question, both sides should acquiesce without making much ado, however repugnant to either party the decision might be.

Home Railway stocks brightened after being mostly in the dumps. In the circumstances, it is pleasant to record a further rise of a point in Central London Ordinary. Metropolitans and Districts are both slightly lower on the week, the falls in these and the advance in Central London Ordinary having the same cause for their mainspring. City and South London has dropped to 48½, and again the dividend pessimisms have come into play.

British Electric Traction Ordinary are a better market at 12 on the dividend of 6 per cent., having followed the Preference in their last week's rise of ¼. The Debenture stock is being done at 122½. Buenos Ayres and Belgranos are advancing in favour in consequence of the remarkable rise in Argentine railway stocks. The Ordinary shares now stand at 3⅛, the "A" and "B" Preferences at 5½ and 5 respectively. Perth Electric Tramway Debenture stock was bought at 102 a few days ago, and North Metropolitan shares found a market buyer at 2$\frac{9}{16}$. London United Tramways issues are unaltered, and Dublin United Trams keep at 12½ and 15½ for Ordinary and Preference respectively. The Dublin Co. is ordered to pay £1,000 damages to a lady recently injured on their system.

Fresh weakness in British Westinghouse Preference has lowered the price of the shares to 4⅜, and business is being done on this basis. There seems to be no assignable reason for the fall, which now assumes unpleasant proportions; the delay in announcing the dividend, as we remarked a fortnight ago, is not at all relished by some of the proprietors, but as the notification is hourly expected, it may possibly have been made before these lines see print. Crompton Debentures are down 1 per cent., and Electric Construction Debenture has gained the same amount. India-Rubber shares have been in demand upon the excellent report just issued by the company, and are 10s. to the good. Several of the Alkali shares hardened upon the news that the trade war has come to an end. United Alkali Preference are 8, and the Debentures about 100, while Electrolytic Ordinary improved a shade to 10s., the Preference being some 5s. higher than the junior shares.

Amongst Telegraph securities, Anglo-American Deferred has dropped a further ¼, the other two issues of the company remaining steady. The Preferred is in very short supply, and the dealers find themselves hard put to it to get the stock which they have sold. A fair amount of Ordinary came to market not long ago, but this is undergoing conversion, and the scarcity of Preferred is strongly marked, although the quotation has not been allowed to reflect it. Direct United States Cable shares are down ¼, although there is a talk of a revivification of the Yankee Market which should benefit the cable companies if the prophecies mature. There is no alteration among Eastern descriptions beyond a point rise in Eastern Telegraph 4 per cent. Debenture. In the Telephone list, National Deferred recovered after going a couple of points easier, and the 3½ per cent. Debenture stock braced up a shade to 97. Orientals continue quietly firm.

Commercial Cable Co.—The directors have declared a quarterly dividend of 2 per cent., payable on January 2nd, 1904.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Dec. 2nd.	Closing Quotations Dec. 9th.	Business done week ended Dec. 9th, 1903. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¾— 3¼	2¾— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	49 — 52	49 — 52	49½	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	92 — 94	93⅞	92⅝
3,105,580	Do. do. do. Deferred	Stock	5s.	2s.	1/-	7⅞— 8¼	7⅞— 8	7⅝	7⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4¾— 5¼	4¾— 5¼	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155	145 —155	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	92½	91½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101	97 —101	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10¼— 10¾	10 — 10¼	10¼	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	122 —127	122 —127	124	122
1,955,555	Do. 3½ % Pref. Stock	100	..	..	..	84 — 87	85 — 88	87½	86
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106½	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11 — 11½	11 — 11½	11½	11
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	106 —109	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	100	99½
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8½— 8¾	8½— 8¾	8⅝	8 5/16
180,042	Do. do. 6 % Pref.	10	..	..	..	12½— 13	12½— 13	12 3/8	12½
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	25 — 26	25 — 26	25⅜	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	101 —103	101 —103	103	102
1,966,667	Do. do. Def. Stock	100	..	..	4½%	78 — 81	78 — 81	79⅛	77
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	14	13⅜
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	5 3/16
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	103⅜	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅜— ½	⅜— ½	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	.. — ..	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7⅛	6½— 7⅛	..	..
3,808	Submarine Cables Trust	Certs.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	5⅝	5⅜
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾— 5¼	4¾— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	11⅜— 12¼	11⅜— 12¼	12⅛	12
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	100	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,821	West India and Panama Telegraph	10	2%	..	..	7/16— 9/16	7/16— 9/16	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	6⅜	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	4 — 5	5	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —104	101 —104	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4¼— 5¼	4¼— 5¼	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	88 — 92	88 — 92	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11¾— 12	11¾— 12¼	12	11⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¼— 11⅝	11¼— 11⅝	11 11/16	11 5/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	122½	121
100,000	British Insulated and Helsby Cables	5	15%	10 %	10 %	6 — 6¼	6 — 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5¾	5¼— 5¾	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —108	103 —108	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	7/16— 9/16	7/16— 9/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1¾— 2	1¾— 2	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1¼— 1½	1¼— 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	84 — 89	84 — 89	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11 — 12	11 — 12	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5¾	5¼— 5¾	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	92 — 95	93 — 96	94½	..
494,993	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	..	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	96 — 99	96 — 99	98	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	49 — 51	47 — 50	49	47½
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	5 %	1¾— 2¼	1¾— 2¼	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	99 —103	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	2½%	Nil	..	1 — 2	1 — 2	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	72⅜	72½
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¾— 3	2¾— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	99½	98½
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9 9/32— 10¼	9 9/32— 10¼	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18 — 19	18½— 19½	18½	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4¾— 5	4¾— 5	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10¼— 10¾	10¼— 10¾	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	34½	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3¼%	91 — 94	91 — 94	93	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME,	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Dec. 2nd.	Closing Quotations Dec. 9th.	Business done week ended Dec. 9th, 1903. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	⅝— ¾	⅝— ¾	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	116 —119	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10½— 10¾	10½— 10¾	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10 — 10½	10½— 10¾	10 1/16	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅞	10 — 10⅛	9⅛	9 1/16
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛ — 5⅜	6⅛ — 5⅜	5 11/16	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½ — 5	4½ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	105 —107	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5¾ — 6	5¾ — 6	5⅞	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10½— 10¾	10 — 10½	10 1/16	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104	103½
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7¾— 8⅛	7¾— 8⅛	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11¾— 12⅛	11¾— 12⅛	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	108 —111	108 —111	110½	110
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	100⅛	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅞— 6⅞	6¾— 6⅞	6 13/16	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅛	6 — 6⅛	6 3/16	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	104 —107	104 —107	105⅛	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11⅛	10½— 11⅛	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅜— 18⅜	17⅜— 18⅜	18	17⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	4⅛ — 4⅜	4⅛ — 4⅜	4⅛	4 3/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	12½— 13½	12½— 13½	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14½— 15½	14⅝	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	7½ — 8⅛	7½ — 8⅛	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	8 — 8½	8 — 8½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	— —	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3⅛— 3⅜	3⅛— 3⅜	3 3/16	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	4 1/8	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	11⅛— 12⅛	11⅛— 12⅛	12⅜	12¼
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6⅛	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, December 9th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	33/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	236/-	1/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £130	..
e Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
e ,, Tube (brazed)	per lb.	8¾d.	..
e ,, ,, (solid drawn)	per lb.	7¼d.	..
e ,, Wire, basis	per lb.	7d.	..
c Copper Tubes (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn) ..	per lb.	9¾d.	..
g Copper Bars (best selected ..	per ton	£71	..

METALS, &c. (continued).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
c ,, (Electrolytic) Bars ..	per ton	£68	..
c ,, ,, Sheets ..	per ton	£78	..
c ,, ,, Rod ..	per ton	£75	..
c ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	8/11 to 4/0½	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	41/6	1/2 dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 7 6 to £11 10	..
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 5	..
d Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large ..	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£126 to £127	£3 to £4 inc.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p White Anti-friction Metals—"White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	
	Aberdeen	Dec. 5	1,066	+251	33,817	+ 5,756	10	—
	Birmingham	,, 5	4,890	+ 76	249,090	+ 3,717	—	—
	Bournemouth	,, 2	734	—	—	—	10½	—
	Blackburn	,, 4	695	— 4	30 972	+ 891	12½	+1½
	Blackpool	,, 3	269	+ 2	86,798	— 184	3½	—
	Blackpool and Fleetwood	,, 5	182	+ 12	20,2:6	— 126	7½	—
	Blackpool and Lytham ..	Nov. 19	167	+ 87	459	+ 209	—	—
	Bolton	Dec. 6	1,566	+ 99	66,546	+ 7,967	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 6	696	+ 56	33,935	—	7½	—
	Bristol	,, 4	4,978	+144	—	—	28	—
	Burnley	,, 5	774	+142	—	—	7½	—
British Electric Trac. Co.	Barnsley District	Nov. 27	165	+ 10	8,549	— 20	4½	—
	Devonport	,, 27	435	+ 69	21,910	+ 1,413	5	—
	Dudley—Stourbridge..	,, 27	702	+ 58	39,701	+ 3,726	18½	—
	Gateshead	,, 27	869	+ 61	41,6:9	+ 5 352	10½	+ ½
	Gravesend—Northfleet	,, 27	212	+ 45	11,499	+ 1,215	3½	—
	Greenock—Pt. Glasgow	,, 27	508	+ 59	26,008	+ 2,188	7½	—
	Hartlepool	,, 27	242	+ 36	12,869	+ 824	6½	+2
	Kidderminster	,, 27	96	—	6,076	+ 169	4½	—
	Merthyr	,, 27	190	+ 34	9,452	— 26	8	—
	Middleton	,, 27	283	+ 14	15,097	+ 1,841	8½	—
	Oldham—Ashton ..	,, 27	502	+ 10	27,008	+ 1,589	8	—
	Peterborough	,, 27	112	—	6,998	—	—	—
	Poole	,, 27	226	+ 28	14,424	+ 2,076	8½	—
	Potteries	,, 27	1,544	— 75	75,219	+ 3,487	28½	—
	Rothesay	,, 27	37	— 2	6,846	+ 1,601	2½	—
	Sheerness	,, 25	47	—	2,656	—	2½	—
	Southport	,, 27	247	+ 44	14,928	+ 2,618	5½	—
	South Staffordshire ..	Nov. 27	1,017	+406	43,551	+ 7,656	21½	—½
	Swansea	,, 27	450	+ 23	24,645	+ 2,0:0	5½	—
	Taunton	,, 27	47	— 4	2,879	— 200	1½	+1½
	Tynemouth	,, 27	200	— 3	14,870	+ 781	8½	—
B.E.T. Co.	Weston-super-Mare..	,, 25	28	—	5,644	— 514	2½	+2½
	Wolverhampton Dist.	,, 27	346	+ 37	18,522	+ 7,646	10½	+8
	Wrexham	,, 27	111	—	4,:05	—	—	—
	Yorks. Woollen Dist. ..	,, 27	487	—	15,721	—	6	—
	Cardiff	,, 28	1,794	+287	69,460	+19,150	14	—
	Chatham & District Co.	Dec. 3	479	+155	25,985	+13,861	8·53	—
	Dover	,, 5	167	+ 7	10,719	+ 55	3½	—
	Dublin	,, 4	4,059	— 81	117,188	+ 7,624	46½	+ ½
	East Ham	,, 5	529	+123	24,386	+ 7,175	5	+ ½
	Glasgow	,, 5	13,142	+1038	369,462	+98,117	66	+ ½
	Hull	,, 5	1,804	+147	67,472	+ 3,856	11½	+1
	Ilkeston	,, 2	122	—	—	—	4	—
	Isle of Thanet	,, 5	221	+ 40	32,522	— 1,579	10½	—
	Leeds	,, 5	4,855	+337	199,918	+12,112	41	—
	Liverpool	Nov. 28	9,582	+418	483,457	+15,970	103	—
	Manchester	Dec. 5	10,565	+3181	421,949	+250,297	72	—
	Newcastle	,, 5	3,337	+325	—	—	17	—
	Portsmouth	,, 5	1,201	+ 36	65,989	+ 3,951	14½	—
	Salford	,, 7	3,464	+767	128,040	+40,788	30	—
	Southampton	,, 3	808	— 87	—	—	9	—
	Sunderland	Nov. 22	1,055	+ 83	42,776	+ 2,083	20	+3
	Central London Railway	Dec. 5	7,091	— 50	146,101	— 6,910	6	—
	City and S. London Ry.	,, 6	3,187	—364	61,187	— 9,900	6½	—
	Dublin and Lucan Rlwy.	,, 6	84	—	2,940	+ 174	6½	—
	Liverpool Overhead Ry.	,, 6	1,504	+ 34	38,250	+ 2,462	6½	—

* Compared with the corresponding period of 1902.

THE BRITISH ASSOCIATION, SOUTHPORT, 1903.

THE RESISTANCE OF ROAD VEHICLES TO TRACTION.

(*Continued from page* 841.)

II.—*Suggestions by Mr. J. B. Diplock.*

The following suggestions with regard to trials of wheels for heavy traffic were submitted to the Committee by Mr. B. J. Diplock (member) at a meeting held at the Society of Arts, London, on Friday, May 15th, 1903:—

Assuming that:

1. All wheels are coned or straight in cross-section;
2. All roads are arched or flat in cross-section;
3. It seems evident that coned wheels on flat roads (fig. A), or flat wheels on arched roads (fig. B)—

Fig. A.

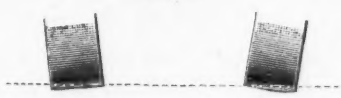


Fig. B.

cause increased road resistance in proportion as the wheels are coned or the roads arched in relation to each other, and that the same result is caused by inequalities in the road surface—viz., that wide tires do *not* obtain an even bearing throughtout their entire width, except on very soft and yielding ground.

Starting from the above statements, and as the results of long experience and observation, he had come to the conclusion that for *heavy* traffic, wheel tires of *more* than, say, 9 in. in width have, in practice little or no material value as tending to reduce road resistance or damage to the road surface, and he suggested that experiments might be carried out with a view to testing the accuracy of this conclusion.

Assuming that 9 in. were adopted as a useful maximum width of tire for heavy haulage on average roads, he submitted the following theory:—

1. That the supporting power of a road is limited by the cohesive friction of the road molecules or particles against each other.
2. That this supporting power limit varies very considerably according to the material used in constructing the road and the moisture absorbed in the road.

He would be prepared to find that road resistance up to certain limits of weight on each wheel (for each class of road) varies approximately in direct proportion to the increased weight on each wheel.

He was of opinion, however, that if this limit of weight per wheel is exceeded so as to overcome the frictional cohesion of the road molecules against each other, then an entirely new set of conditions arises; and he would be prepared to find that road resistance would, under such conditions, increase altogether *out* of proportion to increased weight on the wheels.

He urges that the Committee take steps to ascertain:—

1. The maximum "useful" width of tire for *heavy* traffic on average roads.
2. The "limit" of weight on each wheel (for various classes of road) up to which road resistance increases in direct approximate proportion to the increase of weight on each wheel.
3. The rate of increased road resistance when that limit is *moderately* exceeded.

III.—*Papers read at the International Congress on Automobilism, Paris*, 1903.

By permission of the British Association Committee a paper was read at the Congress by Prof. Hele-Shaw on the work which has been carried out during the past year.

He gave a description of the British Association dynamometer, recounting the reasons why it was decided to adopt the one-wheel trailer, and then gave a *résumé* of the experiments which have been made. The paper was illustrated by photographs and diagrams.

Abstract of Paper by M. Gerard Lavergne *on Tractional Resistance:—Tractive Effort—Springs—Effect of Nature of Tire—Air Resistance—Power required by Automobiles.*

Tractive Effort.

In his paper M. Lavergne referred to the Report of this Committee read at the Belfast meeting last year, and gave some particulars of similar experiments made in America. He stated that Prof. Ira O. Baker, of the Illinois State University, is of opinion that the axle friction is independent of the speed, but varies inversely as the square root of the load supported. Where the vehicles carried only a light load, the coefficient of friction was about 0·02; heavy loads gave an average of not more than 0·015, while with exceptionally heavy loads this coefficient fell as low as 0·012. These values assume efficient lubrication; with indifferent lubrication they rose to as much as six times the amount.

Concerning rolling friction Prof. Baker believes that the resistance varies inversely as the square root of the diameter of the wheels.

The values above given for axle friction differ somewhat from those given by M. Forestier, who gives 0·01 for an ordinary bearing lubricated with cart grease, 0·10 with patent axle-box lubricated with oil, 0·005 with lubricated ball-bearings, 0·0025 with the lubricated "Philippe" bearings (which last-named are ball-bearings having small balls between the larger ones, thus obviating friction amongst the latter and ensuring an equal distribution of pressure upon all the balls).

To thoroughly understand the difference between these sets of figures it would be necessary to know the exact conditions of lubrication and the nature of the bearings employed by Prof. Baker.

M. Lavergne does not consider that the differences shown are very surprising, as we know that the coefficient mentioned by M. Forestier has reference to a patent journal, the wheel revolving evenly in a plane, without lateral jerks, whilst a wheel revolving in less favourable conditions—as, for instance, on a rough paved road—would give a higher figure. The most important fact shown by Prof. Baker's experiment is that the friction of the journal varies with the load upon the axle.

M. Jeantaud made some experiments on road resistance with an electric vehicle. Such an automobile is eminently suited for this work, on account of the perfect sensibility and absolute accuracy obtainable. He used for these experiments a car having four equal wheels fitted with Michelin tires 840 by 90 mm.; the front axles were 40·0 mm. diameter and the back axles were of tempered steel in bronze hubs, the diameter being 55·0 mm. The car with four persons weighed 1,780 kilos., or 3,925 lbs.

At a speed of 15 kilometres per hour, or 9·32 miles per hour, this car required a current of 22 amperes at 80 volts—that is 1,760 watts.

If 15 per cent. is deducted as the friction of the motor itself, the energy of propulsion is 1,496·0 watts, or 149·6 kilogrammetres per second.

Working this out in English units, we have a total tractive effort of 81 lbs. or 46 lbs. per ton.

M. Jeantaud has calculated with Morin's formulæ and coefficients.

First.—The rolling friction, by the formulæ,

$$F_r = f \frac{P}{D},$$

in which f is a coefficient expressed in kilogrammes, varying with the nature of the road and the width of the tire, the value of f for a smooth dry road being 0·010; F_r is the rolling friction; P is the total load on the vehicle in tons; and D is the diameter of the wheel.

Second.—The axle friction by the formulæ,

$$F_a = s \frac{d}{D} p,$$

in which s is a coefficient expressed in kilogrammes (varying with the mode of lubrication and the nature of the rubbing surfaces) and being taken as equal to 0·015.

d is the diameter of the axle, and p the weight of the car without the wheels.

Adding these two resistances and multiplying the total effort by 4·16, the velocity in metres per second corresponding to 15 kilometres per hour, the work done per second is 182·274 kilogrammetres, or 1,320 ft. lbs.

This figure would be that given for an iron-tired vehicle, the only kind employed at the time of M. Morin. According to M. Michelin, the advantage obtained by using pneumatic tires over iron tires on a road similar to the above would be at least 15 per cent. Taking 15 per cent. off the figure obtained, the work expended on traction is reduced to 154·933 kilogrammetres, or 1,120 ft. lbs. per second. This value is very near to that actually obtained, viz., 1,496 kilogrammetres per second (1,084 ft. lbs. per second), and this proves the correctness of the values given for the coefficients f and s.

In January, 1903, M. Jeantaud, with the same electric automobile, between the bridges of Bineau and Neuilly, on a stretch of road just 1 kilometre in length, showed that the tractive effort for a road covered with thick mud was, as General Morin found, quite double that on a dry road.

On January 20th, on the road in question, being then very muddy, the track was covered on the third speed in 4 minutes, with a current of 30 amperes at 80 volts. In English units this would be a mean speed of 9·32 miles per hour or 13·66 ft. per second, with a total tractive effort of 130 lbs., or 74 lbs. per ton.

On January 21st, over the same kilometre, hardened by the frost and very smooth, on the third speed the track was covered in 3 minutes 28 seconds with a current of 20 amperes at 80 volts. This speed would be equivalent to 10·80 miles per hour of 15·80 ft. per second, with a total tractive effort of 75 lbs., or 42·7 lbs. per ton.

Thus the tractive effort was 42·3 per cent. less on the hard road than on the muddy road at the third speed. On the fourth speed M. Jeantaud found that this difference increased to 50 per cent.

These experiments confirm those of General Morin and show the accuracy with which that ingenious man carried out his work. But they have to be made at speeds near to those used by Morin, and it is not at all certain that other experiments, at much higher speeds, under the new conditions of automobilism, so different from those of the iron-tired vehicles, would give corresponding results.

Springs.

When pneumatic tires are used, it must not be thought that springs can be dispensed with, as the duty performed by the tire is

quite different from that of the springs. The pneumatic tyre does away with the slight vibration caused by the wheel encountering gravel, stones, and small obstacles generally, but the height of the axle from the ground scarcely varies, as the tire absorbs within itself these small objects.

Experience has proved that these small vibrations, if not absorbed by the tire, would be transmitted through the springs to the body of the car to the great discomfort of its occupants, and would tend to reduce the life of thetmotor, owing to the crystallisation of the parts subjected to strain.

But the pneumatic tire will not yield much more than 1 in, and is in consequence unable to save the car from vibration when passing over a large obstacle or a deep rut; whereas the springs, with a resilience of, say, 4 in., would be well adapted for this purpose.

Spiral springs have been tried with unsatisfactory results, and they can practically only be used where heavy weights are carried, Plate springs must neceesarily be employed when ease and comfort are desired.

It may be pointed out here that the method of attaching plate springs to the frame is a matter of considerable importance. M. Gaillardet believes that the usual method is not at all satisfactory. The ordinary practice is to use clips which are pivoted to a bracket depending from the frame, these clips being outside of and lower than the normal plane of the spring. From the bracket they rise at an angle of about 45° and meet the ends of the spring to which their upper ends are pivoted. The result is, when the wheel passes over an obstruction of any appreciable size, the axle rises under the centre of the spring, the plates of which lengthen (theoretically) and tend to form a straight line, and at once the load above is thrown upward in the same proportion.

On the other hand, where the clips are so connected with the spring as to work within its length and under its ends, instead of beyond them, any shock given to the wheel causes the load to fall, and the loss of mechanical energy is less.

M. Gaillardet is of opinion that the springs should be so arranged that each wheel is free to rise or fall independently of the others. When this is done, an obstacle under one wheel will raise that wheel only, and the centre of gravity of the whole car is raised a smaller distance than would otherwise be the case. To attain this result he proposes to mount the front axle on a single transverse spring, thus reducing the number of springs on the car to three.

When the springs have been depressed by an obstacle in the roadway, they only return to the position of equilibrium after a number of oscillations of decreasing amplitude have taken place. It is advisable to spare the vehicle this continued oscillation, as, at high speeds, it causes the wheels to leave the ground, and consequently reduces the effective power of the motor. M. Truffault has taken out a patent for an arrangement to remedy this defect. The friction between two metal surfaces prevents the oscillations from arising. He tried a spring fitted with this damping action on a quadricycle, which carried his son to victory over the kilometre to Deauville in 1901. This spring has given very good results, enabling one to travel rapidly even over the worst of paved roads.

(To be concluded.)

LIVERPOOL ENGINEERING SOCIETY.

Presidential Address.

The thirtieth session of the above society was commenced on November 4th by the address of the president, Mr. T. L. Miller.

As is usual in such cases, the address is a sort of review of engineering progress or development, more particularly of the branch in which the president is more directly interested. The cost of the production of power forms the basis of the address, and after touching briefly, and in a very general way, on tidal, wave and wind power, Mr. Miller gives some figures relating to water-power, of which the chief are the following:—

Of the world's total water-power supply we know little: France uses water-power to the extent of 500,000-H.P; America 1,500,000; and Norway 263,000.

According to Prof. Janet, the cost of water-power development in France varies from £4·28 to £30, depending on the head to be dealt with. At Geneva the average cost will work out to £27 per H.P. At Vonvray, a 4,000 H.P. installation will cost £11 per H.P., and at Vallorbe a 3,000 H.P. installation cost only £3·89 per H.P.

The highest capital expenditure appears to be at Lyons, where the cost was £84 per H.P., half of which was spent on hydraulic engineering works.

At Vonvray the cost apparently includes electric generating plant, but it is not clear from the address if any of the others do.

Dealing with the charges for power, Mr. Miller, quoting from various papers, gives the price of 1 H.P. per annum from water-power works, as £18 at Lyons, and an average of £6 in Switzerland.

There is nothing to indicate how the power is delivered, but from the context, it would appear to be electrically. At Niagara, the rates depend upon the quantity, rising from 0·32d. per unit for 80,000 to 200,000 units per month; 0·375d. for 10,000 to 20,000 units per month to 1d. per unit for 1,000 units and less per month. In France and Switzerland, the cost varies from 1·05d. per unit for small powers, to 0·63d. for large powers. In Georgia and South Carolina, electrical energy for power purposes is sold to consumers requiring 1,000 H.P. and over for £3 2s. 6d. per horse-power per annum, delivered on the secondaries of the transformers. The energy can be used for 66 hours a week—3,432 per annum. If full advantage were taken of this, the cost would work out to 0·218d. per unit.

Touching on the question of fuel economy, brief mention is made of the peat bogs in Ireland. "There are," says the author, "one million acres of bog, 10 ft. to 30 ft. deep. which some day will doubtless be utilised, and will, in all probability, prove as profitable an undertaking as it has done on the Continent."

In discussing the calorific value of coal, a table prepared by the late Bryan Donkin, is given as under, to show the relative steam values of different priced coals:—

Kind of fuel.	Cost of fuel per ton.	Water evaporated per lb. of fuel.	Cost of fuel per 1,000 gallons evaporated.
Dust coke	5s.	6 lbs.	3s. 8d.
Dust Welsh coal ...	10s.	8 lbs.	5s. 3d.
Large " " ...	22s.	9 lbs.	10s. 11d.

The cheap fuel comes out cheapest, but to the cost there is, of course, to be added extra stoking charges, and also the increased expenditure on boilers to get the same evaporation as with the better fuel.

Turning to utilisation of steam in the steam engine, it is shown that no very great advance has been made in economy since 1840, when, in Cornish pumping engines, one I.H.P.-hour could be produced with a fuel consumption of only 1·7 lbs., and working at such low pressures as 35 to 40 lbs. per sq. in. Tables of steam consumptions in reciprocating engines and turbines are given, covering much the some ground as Mr. G. Wilkinson's paper.

After touching upon gas and oil engines, the cost of producing power from fuel is discussed at some length. He showed the improvement that had been effected since 1894, when Colonel Crompton prophesied that the day would come when, with an output of 5,000,000 B.O.T. units per annum, the cost of production and distribution in places where coal costs 20s. per ton, would work out at 1·32d., of which the works cost would be 0·75d. At that time the record was held by Manchester with a works cost of 1·49d. Mr. Hammond in 1898 prophesied that the total costs at Leeds would fall to 0·75d., when an output of 5,000,000 units per annum was reached.

Last year the actual figure for Leeds, with an output of 4½ million units was 0·89d; Bootle, with 1½ millions was 0·88; Bolton, with 3¾ millions was 0·81, and Bradford, with an output of 9 million units, worked out to 0·75d. per unit.

For purely traction work the works cost at Dublin, with an output of 7½ million units are 0·62d., and at Glasgow, with 10½ millions, the works costs are 0·60d. These figures represent the cost of energy delivered to the switchboard and do not include distribution losses.

The only power scheme which has been in operation for one year is Newcastle-on-Tyne, where the station costs are 0·324d. per unit delivered at the switchboard. The charges for power by this company are £3 10s. per annum per KW. demanded, plus 0·35d. per unit. "This," says, Mr. Miller, "is equivalent to 2·65d. per unit for the first hour's supply at maximum demand, and 0·35d. per unit for the subsequent supply." How many people have been misled and confused by this expression, "first hour's supply." What does it mean—first hour per day, per week, per quarter, or what? No wonder the lay mind fails to grasp the inner meaning of the "maximum demand" system, when the president of a scientific society describes it so loosely.

Dealing with isolated installations, the following figures are given. At Vickers, Sons & Maxim's two works, the works cost are respectively 0·579d. and 0·469d. per unit. At Cadbury's works, with Mond producer gas (without recovery plant) the works cost per unit is 0·344d.

In conclusion, Mr. Miller referred to the waste energy in blast furnace gas which it has been estimated is, in the world's furnaces, equal to 6,400,000 I.H.P., reckoning on an output of 40,000,000 tons of iron a year.

MECHANICAL STOKERS.

A PAPER on the above subject was read by Mr. Albert Gay before the Society of Engineers on November 30th at the Royal United Service Institution. The paper was well illustrated, but Mr. Gay was somewhat inconclusive. Various stokers were referred to, including the chain grate, Vicars, the underfeed, the Erith and the E.S. stoker, Meldrum's and Proctor's. The principal thing shown was, that mechanical stoking enabled a cheaper class of coal to be burned, and their economy, therefore, arose from this fact. Mr. Gay presented a large number of questions and answers which he had obtained from various chief engineers, which were also very diverse and inconclusive.

After referring to the general desire and the various attempts to bring about the more economical utilisation of energy in general and of electrical energy in particular, the author preceeded to show that in order to obtain the best results from coal, perfect combustion was essential. He pointed out, however, that though that result might be possible, in the laboratory, under ideal conditions, the means of obtaining it in every-day practice had yet to be discovered. He observed, however, that good work had been done, and proceeded to describe the necessary requirements of an ideal mechanical stoker. He then described various appliances of the kind, the aim of the makers of which was to approach the ideal as nearly as possible. He divided the different kinds of mechanical

stokers into two main types, viz., top-feed and under-feed; the former being divided again under the sub-divisions of sprinklers and cokers.

Tables of tests of hand firing and mechanical firing were given, some from tests conducted by the author, and others obtained from makers of the appliances, and there was seen to be a general agreement between them. The tables indicate that with coal having a calorific value of 12,000 to 13,000 B.Th.U per lb., fired mechanically, the result is nearly equal to coal hand-fired, having a calorific value of 14,000 to 14,500 B.Th.U., and that by using a lower grade coal than could be economically fired by hand, a saving of from 6s. to 7s. per ton might be effected. The author left for discussion the problem of high-grade and low-grade coal where railway carriage (as in London) forms a large part of the actual cost delivered.

The advantages claimed by makers and the disadvantages claimed by some users were also dealt with. While the author generally indicated his appreciation of the improved economy of mechanical over hand firing, he apparently is not at present satisfied with the reliability and cost of up-keep of stoking appliances.

In the discussion, Mr. Rosenthal pointed out that with the large boilers now used, one or other of the fire doors would be open almost all the time, and it was also difficult to get coal to the boilers, and so on, though we presume coal conveyers will convey coal as readily to a hand stoker as to a machine stoker. He put forward the stoker of his company as a modified form of Jucke's grate, though we can hardly find where the modification comes in.

He was understood to say that he was prepared to pay handsomely for any suggestion for improving it, a challenge promptly accepted by Mr. W. H. Booth, who pointed out that the trouble with the chain grate was the enormous influx of air through the burned-out fire at the back end of the grate. This had been remedied by Mr. Eckley B. Coxe, who caused the grate to move over a series of box divisions of a trough which lay under the grate. Air was admitted to one division freely and passed up through the thick fire in the grate above that division of the trough. Air leaked freely into the next division, and with difficulty into the third, and in this way the air was regulated to the fire thickness. He considered Coxe's device was the only hope for this grate, and it was very valuable, and he trusted to receive a cheque from Mr. Rosenthal, who, however, made no apparent endeavour to "dree his weird." The same speaker pointed out, as a general principle, that stokers to be successful should keep their grates covered. In some, such as the underfeed, and certain of the step-grate variety, the movement of the bars, combined with gravity, caused the fuel to move down and close up the bare spots on the grate.

Mr. Watkinson had tried many stokers, and at present he was most friendly to the underfeed type. He supported the previous speaker as regards the air leakage through the bare back end of chain grates, which he looked on as the worst of all stokers. We may mention that certain chain grates in use at the Bradford Electricity Works are fixed on a slope towards the back end, and this appears to be a valuable innovation, if not detrimental to the grate in other ways. Mr. Bennis spoke well and at considerable length. We need hardly say that he is naturally full of stokers, and we understood him to say he could go on for a year, but he would spare us, and after a very interesting speech, which should be helpful to Bennis business, he promised any further desired particulars which, he hoped, would be quite free from the taint of trade, for he did think that, at such meetings as this, trading should be abjured.

There were few dry eyes after this touching appeal. When did ever a Bennis or a Proctor not black each other's metaphorical eyes, and in it all did they ever bring in trade? Perish the thought! Mr. Erith also spoke. We think he was roused to action by Mr. Bennis's figures of some 87 per cent. of boiler efficiency still being done, as Mr. Bennis added. But Mr. Erith did not allude to the figures, though we know they rankled. He may console himself at least with the knowledge that those figures were like certain household gods, there for looking at, but not to be believed. At least, we credit others with the same incredulity which such figures always raise in ourselves.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE TESTING OF ELECTRIC GENERATORS BY AIR CALORIMETRY.

By RICHARD THRELFALL, M.A., F.R.S., Member.

(*Abstract of paper read November 26th*, 1903.)

To Prof. Threlfall belongs the honour of "leading off" the session, with a paper on the testing of an alternator by means of a calorimetrical method devised by himself.

The occasion arose through the necessity for obtaining the efficiency of a plant where structural difficulties, such as the field magnets being built on to the fly-wheels, rendered it impossible to measure the B.H.P. of the engine. It was equally impossible to couple two similar machines as motor and alternator respectively, and the author adopted what appeared to be the only course open to him, viz., to enclose the alternator in a non-conducting casing, and to pump air through the system at a measured rate. Assuming that an accurate method of measuring the air current could be found, it would then only be necessary to compute the rate of dissipation of energy in the alternator, the temperatures of the air entering and leaving the system being easily obtainable.

The efficiency of the generator is, say, $\frac{\rho^1}{\rho^1 + H}$, where ρ^1, the output of the generator, can be measured electrically in KW., and H, also stated in KW., the rate at which energy is carried out of the system, can be measured with sufficient accuracy. On the latter point the author draws attention to the fact that H is the actual loss, and therefore an error of as much as 10 per cent. in estimating H would only cause about 1 per cent. error in a machine with an efficiency of 90 per cent.

The author proceeds to show that the energy gained by a kilogram of dry air in rising 1° C. at constant pressure under standard conditions is 993 watts, if the gain of temperature is a degree per second, and as a kilogram of dry air also equals ·773 cb. metres, 1 cb. metre of air, if heated 1° C. per second, will require 1·277 KW.

Prof. Threlfall's first difficulty in regard to the experiment appears to have been the measurement of the air current, but the results of his investigations showed that measurements of large currents could easily be obtained within 2 per cent.

The measurements were made by means of the Pitot tube for obtaining the velocity pressure, and by means of another tube and manometer, the latter tube being so arranged that it was subject merely to the static pressure of the stream of air.

The writer was able to show that almost exactly half the momentum of the impinging air was destroyed by the quiescent air in the Pitot tube, and the velocity pressure p was, therefore, almost exactly equal to $\rho\frac{v^2}{2}$ dynes per sq. cm., where ρ is the density of air in grammes per cb. cm., and v its velocity in centimetres per second.

Details of the experiments are included in the paper, and the author shows that the velocity $= 12{\cdot}45\sqrt{p}$ feet per second, p being in dynes per sq. cm. The ascertainment of the velocity of air at a certain point in the cross-section of a pipe is, however, only the first step towards discovering the delivery in cb. ft. per sec. To find the delivery it is necessary to know the velocity at every point of the cross-section, and this is obtained by means of a modified form of Pitot tube, with which several points across a diameter of pipe can be measured, and a distribution curve plotted. From this it is comparatively easy to calculate the air delivery.

Fig. 1 shows the arrangement adopted for testing the 300-KW. A.C. generator. The casing throughout was made of ½-in. tongued and grooved boards fastened to 4-in. studding, then papered over with paper faced with bright so-called tin-foil. The alternator wheel pit was also boarded round, and felt ¾ in. thick fastened over.

A window and thermometer (1) were provided at the junction of the entry air duct and generator casing; the opening into the fan-box from the casing was of considerable size, and the temperature was observed at several points in the opening by means of a standard thermometer (5). The air drawn from the casing was then propelled down the measuring pipe to the instrument (5).

By regulating the speed of the fan it was quite easy to adjust the air supply so that the average temperature inside the casing was the same as that of the engine room, the entering air being colder and the expelled air warmer, but owing to the stirring action of the generator the casing was practically at engine-room temperature, and errors due to unconsidered streams of heat were avoided.

The subject of power measurement in alternating current circuits is one not altogether unfamiliar to those who were Members of the Institution of Electrical Engineers in the early, nineties. The trials with which the author dealt were made by taking up the power in a large tank filled with water. The current was led through iron strip measuring ¾ in. wide by $\frac{1}{16}$ in. thick, stretched round large nails driven into heavy boards nailed to the sides of the tank. Care was taken to wind the strip in zigzags about 2 in. apart, and the ends of the strips were brought up to near the surface of the water with which the tank was filled, so as to give some freedom of adjustment of resistance. Connection was made to heavy copper ribbon, or bar, which projected from the mains to the depth of about 2 ft. under water. It was supposed that there might possibly be some doubt in the minds of the parties concerned as to the electrical measurement of the power, and consequently the tank was provided with about 250 ft. of thin 2-in. leaden piping arranged so as to expose its full surface to the stream of hot water set up by the current in the strips, the latter being, of course, nearly at the bottom of the tank. Arrangements were made for sending a stream of water through this lead pipe and passing the stream over weighing buckets. It is obvious that with proper thermometry such a power absorber is a huge calorimeter, and would enable estimates of power to be obtained independent of any electrical instruments whatever. In the result, the electrical measurements were found to be so satisfactory that recourse to calorimetry was not necessary.

The scheme adopted was the following: A suitable kilowatt balance by White, of Glasgow, was tested on a continuous current circuit against multi-cellular voltmeters standardised by cells, and the currents directly measured by a potentiometer and manganin resistance tested by the standardising department of the Board of Trade. The constants supplied with the balance were thus verified to within a fraction of 1 per cent.—in fact, to within the range of possible experimental errors. The tests were carried out with about 80 KW., and care was taken to use about the same electro-magnetic forces with the balance as were subsequently used during the trials. As a check, two independent methods were employed. An oscillograph was procured from the Cambridge Scientific Instrument Co., made according to Mr. Duddell's patents, and this was set up in a special observing house erected outside the engine house. The curves showed

that both pressure and current curves passed through zero at the same instant to within 2 or 3 per cent., *i.e.*, as nearly as could be seen. A new instrument in the shape of a very sensitive hot-wire voltmeter was devised by the author a year before the trials took place. With this instrument it was possible to make measurements of the voltage accurate to about 1 per cent. with less than half a volt as the total voltage in question. The calibration of the instrument is described at length in the paper.

Some preliminary trials were carried out at the suggestion of the makers, a known quantity of heat being introduced, and measured in the manner adopted; the loss due to windage and conduction along the shaft having been obtained, the average error was estimated to be + ·37 per cent. In regard to the windage alone, the author found this to be 2 KW., and he charged half of this to the engine and half to the generator.

The tests for generator efficiency were then carried out, the method adopted being as described, and a summary of results appears in Table I.

TABLE I.

Date. 1902.	KW.	Magnetising current.	T. C.° Inlet.	T. C.° Outlet.	Inlet + outlet 2	Mean temp. of casing back and front.	Heat supply measured. KW.
Aug. 13	301·42	65·9	16·186	32·19	24·2	24·25	38·01
„ 19	0	51·83	19·44	30·35	24·9	28·2	25·04
„ 20	0	66·2	15·415	26·83	21·12	24·75	27·20
„ 20	0	0	24·42	25·97	25·20	24·4	2·066
„ 21	249·2	57·5	20·17	33·54	26·87	30·8	34·16
„ 26	37·8	—	17·99	36·80	27·4	29·4	39·27
„ 28	37·8	—	20·28	38·51	29·39	31·15	40·865
„ 29	262·4	61·2	20·95	36·35	28·65	33·10	34·07

Taking the test on August 13th, which was at the highest load, we can now deduce the efficiency of the dynamo. Allowing 1 KW. loss for windage chargeable to the engine, the generator may be said to waste 37·01 KW., together with whatever *loss* of power there may

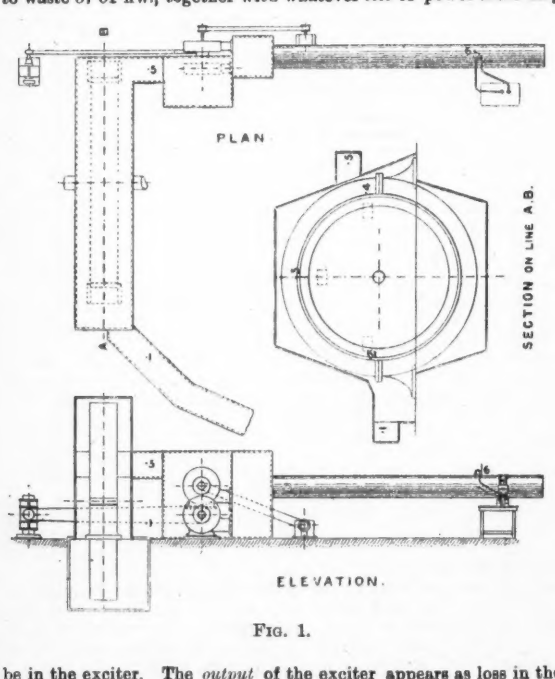


FIG. 1.

be in the exciter. The *output* of the exciter appears as loss in the heating of the magnets, and is duly included. Neglecting the loss of power or heat generated in the exciter itself for a moment, we may say that the generator efficiency is $E = \frac{301{\cdot}41}{301{\cdot}42 + 37{\cdot}01} =$ 89·05 per cent. The exciter current was 65·9 and the external voltage 33·7, say. Assuming that the exciter efficiency is 83 per cent. —it was lightly loaded and of a well-tested type—we may say that its loss is $\frac{17 \times 2{\cdot}221}{83} = {\cdot}455$ KW. Making this correction, the overall efficiency of generator and exciter taken as a single unit is $E^1 = 88{\cdot}93$. There is in this case no addition to be made for belting, as the exciter was mounted on the end of the main shaft. The friction in the outer and inner bearings is perhaps unjustly charged to the engine, on the ground that the fly-wheel carrying the magnets could not work without two bearings, as stated above. On the other hand, the engine is handicapped by having the extra weight of the magnets to contend with, *i.e.*, the mass per unit moment of inertia of the fly-wheel is greater than it would have been had the wheel been designed for a given moment of inertia without the limitations imposed by the alternator ring.

The question arises as to how the losses observed are made up. In the first place, the copper magnetising loss is small, being 2·221 KW. in the test considered. In the second test in the table, viz., that on August 19th, the alternator being run on open circuit, the magnetising current was adjusted so as to give the same internal alternating voltage as had been used during the full-load trial; the magnetising current was 51·83 amperes, corresponding to a loss of about $\frac{2{\cdot}221 \times (51{\cdot}83)^2}{(65{\cdot}9)^2} = 1{\cdot}37$ KW. At the same time the total loss in the casing was 25·04 KW., so that subtracting windage loss, viz., 2·066 KW., as well as the Joulean waste in the magnet windings, we have 25·04 − (2·066 + 1·37) = 21·60 as the iron losses pure and simple, the iron being brought up to the same induction as during the full-load trial. Now, if we treat the loss at full load in the same way, we find the iron loss + the copper loss in main conductors = 38·01 − (2·066 + 2·221) = 31·723.

An estimate can easily be made of the copper loss from the measured resistance of the alternator, making some allowance for "skin effect," which, however, is not important, the conductors being of rectangular section and four times as wide as they are thick. Frequency about 40 cycles per second. The copper loss at full load is therefore about 3·07 KW. Subtracting this, we have as the iron losses at full load 33·723 − 3·07 = 30·653, and at no load, 21·60.

It occurred to the author that this difference might perhaps be accounted for by the iron losses in the cores of the *magnets* at full load. The machine had been purposely designed for a constant KW. output with varying external resistance and large overload capacity—necessitating a high armature reaction—and it was evident that this must mean considerable fluctuation in the inductance of the cores and a corresponding fluctuation of the magnetising current.

As soon as the dynamo efficiency is known it becomes the best possible "brake," and we may proceed to examine the behaviour of the engine. The engine in question was most carefully indicated over the period of the tests already mentioned, and the following figures were obtained, the engine being a two-cylinder tandem gas engine:—

Gross total, I.H.P.	517·05
Absorbed in pumping and friction at no load...	70·00 (indicated)
Mechanical efficiency resulting	86·5 %
Mean power	301·42 KW.
Dynamo efficiency overall	88·93
Resulting KW. delivered by engine	338·9
Indicated KW.	385·75
Resulting mechanical efficiency	87·86

This is possibly the most reliable result hitherto obtained for a gas engine of this size.

The discussion which ensued was opened by Mr. W. B. ESSON, who commented upon the novel method employed by Prof. Threlfall. He considered that it would require expert experience in use; in fact, the method would test the operator as much as the machine he experimented with. He agreed with the author that the unascertained loss (amounting in this case to some 3 per cent.) must be credited to the iron loss in the cores of the magnets at full load, and this pointed to the necessity of connecting the poles right through if the best efficiency was wanted.

Dr. GLAZEBROOK referred to the method adopted by Lord Rayleigh in obtaining the velocity pressure coefficient; the difference between his figure and that given by the author was due to a difference in the Pitot tube. Experiments showed that the Pitot tube gave very accurate results in measuring a stream of air.

Mr. MORDEY was interested in the experiments owing to their bearing on the problem of conveying gas through large pipes, which he was interested in. He considered it as an objection that the method would take too long a time to get a reliable observation, although it might be useful in a works.

Prof. THRELFALL, in reply, assured his hearers that any one who could read a thermometer could carry out the tests; if anything the greatest difficulty lay in accurately measuring the electrical output. It was not a quick test, he believed four to six hours under full load would be required to get results similar to those he recorded (*i.e.*, well within 1 per cent.), but an hour would give a rough test. The curve of velocities given in the paper was selected as one of the worst possible. He pointed out that, shorn of the many corrections which it was necessary to introduce in the first few tests, the method was a straightforward one, and would not suffer from inaccuracies more than other tests of a similar nature.

Abstract of Inaugural Address delivered to the Dublin Section, by Prof. W. E. THRIFT, chairman; November 12th, 1903.

The Chairman first dealt with current topics of interest, touching on the need for papers, the Institution Wiring Rules, the Nernst lamp, vapour-pressure engines, &c., after which he referred at some length to the properties of polyphase motors, *à propos* of the new three-phase supply system in Dublin. After describing the Heyland system of "compensating" induction motors so as to give large starting torque and high power factor, the chairman showed that it had important properties when applied to induction generators, enabling the latter to be compounded, to be made self-exciting, and to be paralleled with other generators without previous adjustment of the speed to synchronism. Various types of single-phase motors, including the repulsion and series types, &c., were also touched upon. Prof. Thrift then turned to "recent advances in the domain of pure theory," in connection with radiation and the constitution of matter. The rays discovered by Blondlot, he observed, fitted into the gap between the infra-red rays and the shortest wave-length Hertzian rays, and appeared to have the property of increasing the luminosity without increasing the temperature of luminous bodies. The peculiar properties of the Cooper-Hewitt

mercury-vapour lamp, both as a source of light, and as a rectifier, were of great scientific importance. The discovery of the radio-activity of uranium, thorium and radium, however, was far more momentous. The respective properties of the α and β rays emitted by these substances led to the conclusion that both kinds were projected particles, the former charged positively, the latter negatively. Besides these rays, and a gaseous emanation, radium emitted a totally different kind of rays, and maintained its temperature above that of its surroundings, and the disintegration of the emanation was found to result in the formation of helium. Radio-activity was probably a widely distributed property of matter, and had been obtained in a variety of ways.

The Chairman pointed out the remarkable ease with which the disintegration theory accounted for all the effects produced by the radio-active bodies which had been observed. Apparently the atom of such a body was unstable, and disintegrated, emitting positively charged particles (α rays), negative electrons (β rays), and γ rays, until a stable residue remained which, on account of its stability, could not be detected by the methods applicable to radio-active bodies.

The kinetic energy of the particles emitted in the α rays during the breaking-up of one gram of radium was at least as great as the energy set free in the chemical union of the hydrogen and oxygen required to produce 25,000 grams of water, than which, weight for weight, no other chemical reaction was more energetic. The heat continually emitted by one gram of radium would boil one gram of water in an hour.

The new method of investigation was immensely more sensitive than even the most refined methods of chemical investigation; we were actually within range of observing the effects of the disintegration of a single atom of uranium, whereas the chemical balance could weigh 10^{14} atoms of uranium.

Calculation set a limit of a few thousand years to the life of radium; various reasons could be suggested for the fact that the substance was still in existence, such as the possibility that radium itself was a product of the disintegration of another radio-active body.

Prof. Thrift then considered the attitude of chemical knowledge towards the new theories, and showed the bearing of the electronic theory upon the constitution of matter, in conjunction with the phenomena of radio-activity, his conclusion being that we might be within reach of a demonstration of the electrical composition of all matter; and finally he pointed out the immense field of research which had been opened up by the discovery of radium and its peculiar properties.

Abstract of Inaugural Address delivered to the Birmingham Local Section by J. C. Vaudrey, chairman, December 4th, 1903

The Chairman commenced by advocating a common home for all Midland Engineering Societies, such as was already possessed by other professions in the Midlands. He then referred to the importance of Birmingham and the surrounding district as an engineering centre ever since Boulton & Watt built engines at Soho, and to the value of the Engineering section of the new University. Mr. Vaudrey afterwards discussed the causes which had hampered the development of electrical engineering in this country, as regards both lighting and traction; these causes were mainly those of vested interests, and the totally different natural conditions obtaining in other countries, and our fiscal policy was in no way to blame. In his opinion we were now making up for lost time; standardisation and high quality of work were essential factors of success, and while practice was all important, theoretical investigation must be vigorously prosecuted. The general use of electrical power in factories was certain to come, and opened up entirely new possibilities in the methods of driving machines. Mr. Vaudrey doubted whether electric traction was being developed to the best advantage; municipalities were absorbing the tramways within their areas, but it was absolutely essential that the outlying districts should be included in the networks, and there were considerable difficulties in accomplishing this under existing conditions.

As regarded electricity supply, full data should be collected in such cities as Birmingham, relating to the horse-power used by means of steam, gas and electricity, to enable the requirements of future years to be provided for with the maximum advantage. The development of large power schemes was an important matter, as the value of cheap power could not be over-estimated.

REVIEW.

Messrs. William Clowes & Sons, Ltd., of 23, Cockspur Street, S.W., have just issued a very extensive code in three volumes, the first being known as the "General Commercial and Mining Telegram Code—Code I.," price £5 5s. net.; the second as the "Multiform Combination Telegram Code—Code II.," price £8 8s. net.; and the third as the "Catalogue Combination Telegram Code—Code III.," price £7 7s. net. Compilers—Messrs. Moreing and McCutcheon.

It has always been a source of great annoyance to merchants and others to be unable to find words in codes to suitably express to their correspondents the message to be conveyed to them, and in this respect we think the above-mentioned codes should supply a long felt want, inasmuch as every probable variation in the use of a word has been apparently provided for. In other ways the codes are also made of the maximum use by an index of words and equivalent expressions, thus enabling users to quickly find the most suitable language in which to clothe the idea they wish to convey to their correspondents.

It would seem that the price of £21 and the bulk of the books must of necessity limit the field of sale, as merchants, other than those of the first magnitude, are as conservative in the matter of spending money on telegrams as on codes, and perhaps £21 might cover their bill for cabling for a year or two.

We think, however, the work should find support for the reason that its scope appears unlimited, and adapted to the use of all, and by reason of its range affords special means for saving in the cost of cabling. The best idea of the magnitude of the work may be gathered from the following figures:—Code I. (2,500 pages) contains 243,000 words and sentences, and 31,000 extra cipher words for tables, &c. Code II. (1,967 pages) contains 206,460 cipher words, eight arrangements of 125,000 numbers, and 960,045 economical numerical combinations for compiling tables, phrases, &c. Code III. is compiled for use with Code II. for catalogues or lists of articles or items (1 to 15,000, 1 to 125,000, &c.) in combination with phrases, quantities, prices, shipments, ports, &c., making 274,979 separate references.

It is, of course, evident that the compilation of the codes has entailed an enormous amount of labour and thought, and we find on examination that great care must have been bestowed upon the choice of words with the object of avoiding as far as possible liability to telegraphic mutilation, but yet in a work of this magnitude it is to be expected that many words should possess too much similarity; for instance, we find the words "kissing" and "vissing," also "surely" and "purely," "heminario" and "seminarios," "creation" and "ceration," "scrolled" and "strolled," "confected" and "connected." Then we think also "wilful" is too near "wilfully," as they follow each other and practically convey a similar meaning. Again, we find words such as "Ernst," "Victor," "Mississippi," Wagner," "Campeche," "Muscavado," which it is generally agreed are not suitable as code words, being proper names. We also think the employment of the letter "é" unadvisable, as there are many instances where this occurs, *e.g.*, "appléger, ebénir, ebénoxyle, exténuais, fainéanter, pséphisme, séduction," &c. In the code we also note the word "stichtsch." We do not think any cable company should accept this as a code, but as a cipher word, and as such it would be chargeable as two, and the whole of a message containing such a word would be charged on the basis of five letters to one word.

No doubt, however, the work will be later reprinted, and in a second edition probably such instances as we have pointed out will be deleted.

The volumes are nicely bound and well printed on bank paper.

THE TESTING OF ALTERNATORS.

Mr Behrend, writing in the *Electrical World and Engineer* for October 31st, 1903, briefly reviews the usual methods of testing large alternators under full load conditions, with a supply of energy only equal to approximately the full load losses.

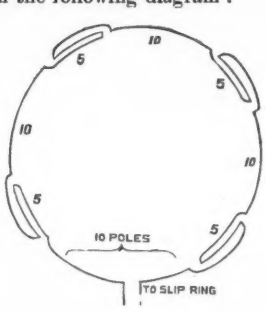
In the method devised by Mr. Mordey, the armature coils are split up into two sections, and opposed so as to obtain full load current and full magnetic flux. Mr. Behrend points out that though this may not have caused trouble in a Mordey machine, it does so in an iron cored alternator, for the armature current, being practically in quadrature with the E.M.F., strengthens the poles opposite to the motor section of the machine, and weakens those of the generator section. Hence the motor field coils carry more resultant flux than the generator field coils. This causes great mechanical stresses due to the magnetic unbalancing.

Having noticed the violent vibrations produced in an alternator of the rotating field type, when running with the armature short circuited and the field divided into two sections, one opposing the other, Mr. Behrend, realising that the magnetic unbalancing was due to the armature current strengthening the motor poles and weakening the generator poles, applied the following remedy :—

Instead of passing the same current round both sections of the field, he excited each half independently. By this simple method, although unable to get the right heating effect in the field, full load conditions were obtained for the armature.

In one factory the rotating thrust due to magnetic dissymmetry is eliminated by dividing the armature, not simply into two, but into several sections. By this plan both the strong and the weak sections are made to balance each other sufficiently well, and at the same time full load conditions are obtained both in the armature and in the field.

For example, a 60-pole alternator of the rotating field type, instead of being divided into two sections of 20 and 40 poles respectively, was grouped in sets of 5 and 10 poles. This is shown in the following diagram :



When connected in the above manner, full load current was obtained in both armature and fields without serious vibration. We hope Mr. Behrend will fulfil his promise and show how his method can be utilised for the determination of the regulation.

NOTES ON ENGINE DRIVING IN ELECTRIC LIGHT STATIONS.

By F. T. CALLIS.

General Conditions.

In no branch of engineering has the growth of the electrical industry produced such changes as in that of the design and building of stationary engines. Engine builders, 15 or 20 years ago, hesitated to attempt reaching the speeds required by the types of dynamos then in use ; the result being that large slow-speed engines were employed coupled to the generators by belts, or, later on, by ropes.

The gradual development of dynamo design enabled a considerable reduction in the necessary speed to be made, and the increase of speed attainable by the engines being built for the purpose, brought the two units on to a more even footing, until at the present time belts and ropes have almost entirely disappeared, and we find the generator coupled directly to, or in some cases carried upon, the engine shaft.

In no other circumstances do engines run under such trying conditions as those obtaining in a large electric supply station, the larger sets running, perhaps, not more than four or five hours a day, and part of that time possibly on a light load, though liable at any moment to be called upon to do full duty.

Moreover, large plants of 1,000 H.P. or more, may have to be started and placed on load at very short notice, and it is under such conditions that skilful and intelligent handling of the plant is absolutely essential.

In central stations where the supply is on an alternating-current system, further skill is required on the part of the driver in running up an engine, as before the machine can be placed on load, the speed has to be adjusted until it is identical, electrically, with that of the machines already on load.

It is very necessary that a driver should realise the seriousness of having to take a plant off load, thereby risking an interruption to the supply.

He should take a living interest in his engines, understand at any rate the main principles which govern the working of them, and be quick to notice any change in the behaviour of any part when running.

Anything unusual that is noticed should, of course, be reported at once to the engineer-in-charge, for him to decide as to the seriousness of the matter, and whether the plant should continue on load or not.

Too frequently when a man finds anything warming up, he endeavours to remedy matters without reporting it, for fear of being blamed, though very likely the cause of the trouble is quite beyond his control.

This practice cannot be too strongly condemned, as if his endeavours fail he is compelled to reveal the trouble, often too late to save the plant having to be shut down and to prevent serious damage being done.

Even if the evil be got over for the time being, it will most assuredly show up at some future time ; this can be prevented if the matter is known and investigated at first.

Types of Engines.

The engine most commonly met with in modern central stations is the vertical high-speed type.

The prevalence of this design is due to the great advantage obtained through the small floor space required for a given power as compared with horizontal engines. The weight and cost per horse-power are also less.

The majority of these engines have the working parts entirely enclosed, and are supplied with oil under pressure.

In arrangement they may be classed as follows :—

1. Compound engines with the high and low-pressure cylinders side by side, the engine cranks placed at an angle of 90°.

2. Cross-compound, where the high-pressure and low-pressure engines are coupled to the two ends of the shaft, the generators being placed between them.

3. Two, or sometimes three, tandem compounds driving on to the same shaft, the cranks being at angles of 90° and 120° respectively.

In nearly all these engines the cylinders and columns are separated by a distance-piece to prevent heat passing down to the column and heating the moving parts and guides.

Sometimes a chamber is formed in the column head, through which cold water is circulated.

Another important advantage of the distance-piece is that the glands in the column head, through which the piston rods and valve spindles pass, prevent the oil thrown on to the rods by the cranks being drawn up into the low-pressure cylinder when the engine is running condensing and is lightly loaded. The quantity of oil lost in this way in engines not fitted with distance-pieces is sometimes appalling, and is most serious where the condensed steam is used for feeding the boilers.

Another engine in general use is the open-front triple-expansion marine type, these in some cases having their own surface condensers, the pumps being driven off the I.P. crosshead.

By far the simplest engine at present in use, and doubtless with a large future in front of it, is the steam turbine. These run at speeds up to 3,000 revolutions in the case of the Parsons, and up to 20,000 and 30,000 revolutions in the De Laval.

Plants of 3,000 H.P. of this type are now working. There is no internal lubrication, the bearings are oiled under pressure, and the running and handling is exceedingly simple.

Methods of Lubrication.

The safe working of all moving machinery depends on an efficient system of lubrication, and in the case of high-speed engines this becomes a matter of vital importance, as a tendency to heat on any of the moving parts due to lack of proper lubrication very rapidly develops to a serious extent unless dealt with at once.

In enclosed engines the crank chambers and bed usually form the oil tanks from which the pumps draw their supply.

delivering it to the bearings, crosshead and crank-pins at pressures varying in different engines from a few pounds to as much as 50 lbs. pressure in large sets.

Drivers should see that water does not accumulate at the bottom of these tanks, this being pumped out every day before the engine is started. It becomes necessary every now and then to remove all the oil and filter it, fresh oil being added afterwards to make up the correct quantity after removing the sludge from the bottom of the tanks.

A certain amount of loss always takes place due to some oil being taken up the rods in spite of the wiper glands, and also to vaporisation caused by the churning action of the cranks and the high temperature at which most enclosed engines work. Cooling pipes are generally fixed in the oil tanks to keep the temperature of the oil as low as possible.

Where the cooling of the oil takes place on the discharge side of the oil pump, as in the Parsons turbine, care should be taken in winter not to turn on the water until the engine is moving and the oil in circulation. The writer has known cases where the relief valve has opened due to this, the oil being cooled to such an extent whilst standing that it became congealed and the pump could not force it through the pipes.

Where lubrication is effected by means of oil boxes and trimmings, more attention is required on the part of the driver than in cases of forced lubrication.

It should always be borne in mind that one drop of oil in the right place is worth many pints thrown out of the oil cups on to the engine bed.

Boxes should be regularly cleaned out to prevent an accumulation of mud at the bottom.

No hard and fast rule can be laid down as to the quantity of oil to be used, as this will vary with different engines and also with the temperature of the engine room. Cylinder lubrication should be used sparingly, especially where the condensed steam is returned to the boilers.

Starting and Stopping Engines.

Too much importance cannot be placed on the necessity for having large engines thoroughly warmed up before starting them. This should be done slowly, so that the expansion of the metal may be uniform, otherwise there is a risk of fracture. Again, if started up cold an enormous quantity of steam condenses in the cylinders and may produce more water than the drains can deal with, or can be passed through safely to the condenser. The relief valve should pass away water trapped in the cylinder during compression, but this does not prevent a heavy shock to the engine motion, especially if the plant is being run up quickly.

Where the cylinders are jacketed, steam is turned into these for warming up, the steam traps draining off the water as it collects. These traps should be blown through occasionally, to make sure they are working. If the jackets to the I.P. and L.P. cylinders are fed through reducing valves it must be seen that these act properly, otherwise the pressure may rise gradually to that of the boilers, if the steam trap happens to stick, and this is not without danger to the jacket. Emergency gears used for instantly cutting off the steam supply to an engine should be tested every day before starting. When several engines exhaust into the same condenser, it may be necessary, when starting up, to close the drain cocks, to avoid dropping the vacuum for the engines on load, as, if these are fully loaded, a serious drop in speed may occur. Under these conditions the low-pressure drains should be fitted with non-return valves, in which case they may be left open, as the valve will close directly the water has been forced out.

In connection with the engine drains there is another point of importance in starting up. If the H.P. and L.P. drains discharge into the same main waste pipe, and the L.P. drains are not fitted with non-return valves, there is a danger of the water blown down the H.P. backing up the L.P. drain into the cylinder.

This same trouble is met with where the drains from piston rod and valve spindle metallic packings are all connected. The water from the H.P. packings backs up the L.P. drains and comes down the L.P. rods and spindles. This can be avoided and all the packings thoroughly drained by a judicious throttling of the H.P. packing drain cocks.

The shutting down of an engine requires almost as much care and attention as the starting of it, and one or two points may be mentioned in connection with this.

In large open type engines running at fairly high speeds, where the engine motion has not the advantage of the cushioning effect of forced lubrication, steam should not be shut off suddenly as soon as the generator is taken off load, but should be gradually reduced, so that some steam is passing through the engine as the speed falls; otherwise, heavy knocking will occur on the top and bottom ends for want of cushioning at the ends of the strokes.

Nor should the exhaust valve be closed whilst the engine is moving at any speed, as air is drawn into the cylinders through the glands and drains and compressed on the exhaust sides of the piston by the energy stored in the fly-wheel.

This has been known to put such pressure on the face of a large D slide valve that it was forced off the face of the ports, and the springs of the balance rings compressed to such an extent that the valve chest had to be opened out and the springs released before the balance ring could work properly. If a jet condenser has been in use and is being taken off load as well as the plant, the engine exhaust valve must be closed before the condenser is shut down, lest through any cause water should be drawn up into the exhaust pipe and cylinder by the vacuum from the jet dome.

It is as well, where a valve is provided for breaking the vacuum, to open this before stopping the pumps, as this is an excellent safeguard.

The first thing to be done after the engine is stopped is to remove all trimmings from oil boxes to prevent needless waste. All working parts should then be carefully felt to see if any have been working above the normal temperature.

All oil pipes fastened on to moving parts and all set screws should be tried.

If the screws fastening the clips round oil pipes are found to continually slack back due to the vibration, this can be prevented by putting a strip of cloth or leather between the clip and the rod. This also prevents the clip wearing a hole in the pipe if any slight movement of the pipe takes place.

On opening the doors or hand-holes of enclosed engines for inspection, the columns will be found full of oil vapour, referred to in Chapter 3. A naked light should never be placed inside the column until this vapour has dispersed, as with air this may form a very explosive mixture.

(To be concluded.)

THE ELECTRICAL FATALITY AT EAST LONDON (S. AFRICA).

In connection with the inquiry into the circumstances causing the death of Mr. Ernest Carl Knobel, of Oxford Street, who was electrocuted in a bath owing to a leakage from the tramway system, the following is an abstract of the report of Mr. John Denham, acting Government electrician and chief electrical engineer to the Railway Department:—

As requested, I have now made full investigation into the cause of the recent bath fatality.

The pole nearest to Mr. Knobel's house carries three distinct currents. One, for supplying the arc lights in the streets, had been entirely shut off from the power station some time before the accident happened. The second circuit is that for supplying electric light to private consumers, and is at 110 to 115 volts, alternating current. The tapping for Mr. Knobel's house is taken off at this pole; the lighting wires, first being led to double-pole fuses, fixed to the pole, are run in a 1 in. iron pipe down the pole, across the road underground at a depth of from 14—18 in., and terminate at the meter fixed to the outside wall of the front room. Tests proved that there was no defect in the wiring.

The third circuit is that for supplying the electric trams. As the present accident was attributable in some manner to the current from the tramway supply, I carried out experiments under artificially produced conditions, similar to those that existed on the day of the fatality. As it was known that the trolley insulator on this pole burned out about this time, a direct connection was purposely made between the trolley wire and the iron pole and the effects were noted. Measurements were first taken of the pressure, if any, that might then exist between the bath itself and the water pipe, and there was found to be a steady pressure of no less than 400 to 420 volts between the two. A group of five incandescent lamps was coupled between the bath and the tap; these glowed brightly, and the pressure remained the same, proving that very little resistance was present. Tests between the water pipe and the bath waste pipe on the stoep gave 420 volts. From the water pipe to the end of

the waste-pipe where it emerges from underground into the gutter at the side of the road, gave about 300 volts. Incidentally, this showed the existence of a high resistance in the waste-pipe in the length between the stoep and the gutter. To discover what pressure existed between portions of the soil round about, spikes were driven into the ground at intervals. 10 ft. apart and 8 ft. from the pole the pressure was about 10 volts; 17 ft. apart and 20 ft. away, 40 volts; 30 ft. apart and on the side-walk no less than 270—280 volts existed, and it was possible to feel a distinct shock when touching the dry earth with the hands separated 2 or 3 ft. On connecting a lamp between two spikes 15 ft. apart on the side path, it glowed brightly. On communicating with the power station, it was ascertained that the current being generated was about 114 amperes, with no cars running at the time, so that this current was passing from the trolley wire to the earth round about the pole. The deceased was to all intents and purposes in direct circuit with the trolley wire. The only substances in contact with earth and within his reach whilst in the bath are the wall on one side of bath, the water-pipe and tap at one end, and the water-pipe and rose above. The wall thereabouts is painted with oil paint to prevent the absorption of splashes of water, and if touched would not have allowed sufficient current to pass to do serious injury; there only therefore remains the water-pipe, tap or rose, one of which must of necessity have been touched. As the medical evidence does not disclose any injury to the hand—say, in the form of a blister—it appears probable that the unfortunate man may have touched one of the spikes surrounding the shower nozzle with his head. These spikes are 5 ft. 10½ in. from the bottom of the bath, and may have been within his reach. The experiments proved beyond doubt that the fatal pressure was communicated from the tramway circuit. The iron pipe, on its way to the meter on the house, happened to touch the waste pipe from the bath. On examining the pipe at the place of contact, a small hole was discovered as if burnt through by the current. The bath was thus directly "alive" from the trolley wire.

From the evidence it appears that, immediately after the accident "flames about 2 ft. high" were noticed at the bath tap. This was due to the current having discovered yet another return route, which took the form of the chain wound round the tap and connected to the bath. During this very brief period the conditions must have changed somewhat, because suddenly the chain became a conductor and allowed a fairly strong current to pass between the tap and the bath. This would largely relieve the pressure previously existing, but it was then too late.

The accident must be considered as electrically unique, as an extraordinary series of coincidences must have been simultaneously present, the lack of any one of which would have rendered the original breakdown practically innocuous.

1. Failure of insulator.

2. The electrical resistance between the pole on one side and the water main and rails on the other, though they were so close, being too great to allow sufficient current to pass to operate the safety device in the power station.

3. The direct connection with the pole of a pipe leading into an inhabited house.

4. The connection of this pipe with another leading to the overflow of the bath. It might have been touching the inlet pipe instead, and in that case would have acted as a protection instead of a danger.

5. The outlet pipe being attached to a dry wall for most of its length, and the bath being on a dry wooden floor, were insulated. The insulation would be non-existent were a proper drainage scheme in vogue.

6. The inlet water pipe was directly connected to the water supply. In some cases bath water is obtained from a tank not directly in contact with the water supply.

7. The inlet pipe was not connected to the bath. It frequently is, sometimes by a similar chain to that which came into action too late on this occasion.

8. A person must be in the act of taking a bath; and

9. This person must touch the inlet pipe during the time that the insulator is burning.

As the phenomenon of a burning insulator is quickly observed, and it takes but a few minutes to notify the power station, the period during which all the other eight conditions must be present is very short. The only method of preventing a possible recurrence of this danger in future, is to have all poles actually carrying trolley wires and all other poles that may become charged from poles carrying trolley wires, electrically connected by a stout copper wire, preferably to the tram rails or to some main water pipe.

NEW PATENTS APPLIED FOR, 1903.

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25,473. "Improvements in sensitive hot-wire voltmeters." R. THRELFALL. November 23rd.

25,482. "Improvements in or relating to apparatus for obtaining variable electrical ignition, applicable to gas engines." L. MELLOR. November 23rd.

25,525. "Improvements in electric starting switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 23rd.

25,527. "Improvements in train-control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 23rd.

25,526. "Improvements in speed-limiting devices." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 23rd.

25,573. "Improvements connected with the adjusting mechanism of electric arc lamps used with cinematograph and other apparatus." H. J. DAWSON. November 23rd.

25,577. "Improvements in electric arc lamps." W. J. DAVY. November 23rd.

25,583. "Improvements in and relating to electro-medical belts." E. R. STANDFIELD and W. E. KENNY. November 23rd.

25,591. "Improvements in induction coils and transformers." V. W. DELVES-BROUGHTON and J. A. COLE. November 24th.

25,633. "Improvements in electric arc lamps." J. W. EWART. November 24th.

25,657. "Improvements in lightning arresters, or devices for preventing overcharging in electric conductors." G. ZAPF. November 24th.

25,663. "Improvements in telephone systems." FALK, STADELMANN & Co., LTD. and L. THURNAUER. November 24th.

25,669. "Improvements relating to electric conductors or cables." S. G. BROWN. November 24th.

25,698. "Improvements in bodies adapted for lighting purposes, and rendered incandescent by heat or electricity." J. H. LADD. November 24th.

25,725. "Improvements in electric signalling for electric railways and street tramways." H. I. ROGERS, E. M. MUNRO and H. BRECKNELL. November 25th.

25,765. "Improvements relating to electrical recording apparatus." D. CERVERA. November 25th. (Complete.)

25,792. "An improved method of agitating solution in order to quicken the electrolytic deposition of metals." J. SPEED. November 26th.

25,814. "Improvements in trolley-heads for electric tramcars." W. WILLENBUCHER. November 26th. (Complete.)

25,847. "An improvement relating to dynamo-electric generators and motors." J. D. R. BLAIN. November 26th.

25,849. "Improvements in electric rheostats." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,850. "Improvements in time-limit devices for electric switches and the like." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,853. "Improvements in insulating material for electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,854. "Improvements in suspenders for overhead electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,855. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,858. "Improvements in windings for dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 26th.

25,870. "Improvements in or relating to electrolytic electricity meters." THE BASTIAN METER CO., LTD. (C. O. Bastian and C. H. Churchill.) November 26th.

25,925. "Improvements in electrical resistances." P. M. A. MATTHEWS. November 27th.

25,969. "An improved safety device for use in electric traction on the contact-stud system." W. GRIFFITHS and B. H. BEDELL. November 27th.

25,970. "Improved current collector for use in stud-contact systems of electric traction." W. GRIFFITHS and B. H. BEDELL. November 27th.

25,990. "Improvements in and pertaining to electrical brush-holders." H. A. MAVOR and MAVOR & COULSON, LTD. November 27th.

25,994. "Electrical shade ring-forceps." T. D. FREW. November 28th.

26,048. "Improvements in railway signalling by means of a line circuit." V. CESAR and E. GUARINI. November 28th. (Complete.)

26,051. "Improvements relating to voltage-regulating devices for alternating-current electric lines." G. FINZI. November 28th.

26,067. "Improvements in advertising appliances applicable for use in connection with telephones and for other purposes." P. F. CORKHILL. November 28th.

26,069. "Improvements in and relating to multiple electric motor control." T. VON ZWEIGBERGK. November 28th.

PUBLISHED SPECIFICATIONS.

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ELECTRIC RAILWAY SYSTEM. F. Mismahl. 162. January 3rd.

RAIL-BONDS FOR ELECTRIC RAILWAYS AND TRAMWAYS. La Compagnie Generale d'Electricité. 258. January 5th.

CONDUITS AND TROUGHS FOR ELECTRIC CONDUCTORS. T. E. Devonshire. 346. January 6th.

ELECTRIC SWITCHES HAVING THREE CONTACT ARMS. Siemens Bros. & Co., Ltd. (Siemens & Halske Aktiengesellschaft, Germany.) 683. January 10th.

ELECTRICAL RESISTANCE, PARTICULARLY DESIGNED FOR HEATING PURPOSES. G. H. Whittingham. (Date applied for under Patents Act, 1901, January 21st, 1902, being date of application in United States.) 1,092. January 15th.

INSULATING MATERIAL FOR DYNAMO-ELECTRIC MACHINES, ELECTRIC MOTORS AND CONDUCTORS. H. Oliver and G. J. Philpot. 1,529. January 22nd.

ELECTRIC WIRING FOR LIGHTING AND OTHER INSTALLATIONS. F. W. Bayliss and J. R. Browne. 2,289. January 30th.

ELECTRIC LIFTS. J. Richmond and R. F. Carey. 2,483. February 2nd.

ELECTRIC SWITCHES. E. Knipping. 2,976. February 7th.

ELECTRIC RAIL BONDS. W. E. Oakley. 3,167. February 10th.

CHEMICAL RECTIFIERS FOR CONVERTING AN ALTERNATING ELECTRIC CURRENT INTO A DIRECT CURRENT. A. Chaplin. 3,420. February 13th.

INTERRUPTERS FOR ELECTRIC CIRCUITS. G. P. McDonnell. 3,719. February 17th.

OBTAINING UNIDIRECTIONAL CURRENT FROM A SINGLE-PHASE OR POLYPHASE ALTERNATING CURRENT SOURCE. P. C. Hewitt. (Date applied for under Patents Act, 1901, October 30th, 1902, being date of application in United States.) 4,168. February 21st.

STORAGE BATTERY PLATES. W. Fairweather. (The General Storage Battery Co., U.S.A.) 4,410. February 25th.

DYNAMO METERS. E. Weston and A. O. Benecke. 4,444. February 25th.

ELECTRIC STOP MOTIONS FOR DRAWING FRAMES. J. Nelson. 5,125. March 5th.

TRANSMITTERS FOR USE IN TELEGRAPHY. M. Koytra. 5,183. March 5th.

ELECTROLYTIC ZINCING PROCESS. I. Skirmay and L. von Kollerich. 5,448 March 9th.

LUMINOUS-VAPOUR ELECTRIC LAMPS. W. Fairburn-Hart. (The General Elec Co., United States.) 5,545. March 10th.

ELECTRO-THERMIC SURGICAL FORCEPS. A. J. Downes. 5,606. March 10th.

ELECTRO-PLATING OF METALS. J. Schiell. 5,693. March 11th.

LAMPS WITH ELECTRIC LIGHTING DEVICE AND SUPPLEMENTAL WICK. A. L. Lind and C. H. Carlsson. 5,698. March 11th.